the PROCESS CONTROL OIL AND GAS JOURNAL

FRANKS *Superior* Power Take-Off...

Franks PTOs are fully field tested with over 2,000 in use.

. . . the heart of a truck-mounted well servicing unit is one reason *why*

1. SUPERINTENDENTS *PREFER* FRANKS ON THEIR JOBS
2. CONTRACTORS *MAKE MONEY* WITH FRANKS

Cruiser

Cruiser unit owned by Jack Watts Well Service Co., Kanawa, Oklahoma contractor.

Franks was the first in the field (1931) with a split-shaft right angle gear box—known as a power take-off—for transmitting power of the truck engine (up to 250 h.p.) to the well servicing hoist. Franks PTO is light in weight, simple, has double opposed Timken bearings. It is designed to transmit continuously more power than the truck motor develops. Franks PTOs are known for their trouble free operation, as any Franks user will testify. Franks success has forced competition to reluctantly provide power take-offs, but you can be sure of the best with a Franks unit and a Franks PTO.

STAR FEATURES

- ★ Legal in weight
- ★ Fastest rig up and down
- ★ Smoothest high capacity clutch
- ★ Hydraulically adjusted and equalized brakes
- ☆ Packaged to fit any standard truck of adequate capacity

FRANKS — Well Servicing and Drilling Units — Tulsa, Oklahoma

"on the SPOT" FIELD SERVICE

Franks Mfg. Corp.
Box 3218, Whittier, Sta.
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Export: 149 Broadway, New York, N. Y.

Only FRANKS offers "on the spot" field service, with stock of parts and factory trained personnel available at: Alice, Compton, Casper, Farmington, Great Bend, Houston, Kilgore, Odessa, Seminole, Edmonton, and Tulsa.

PRICE 50 CENTS

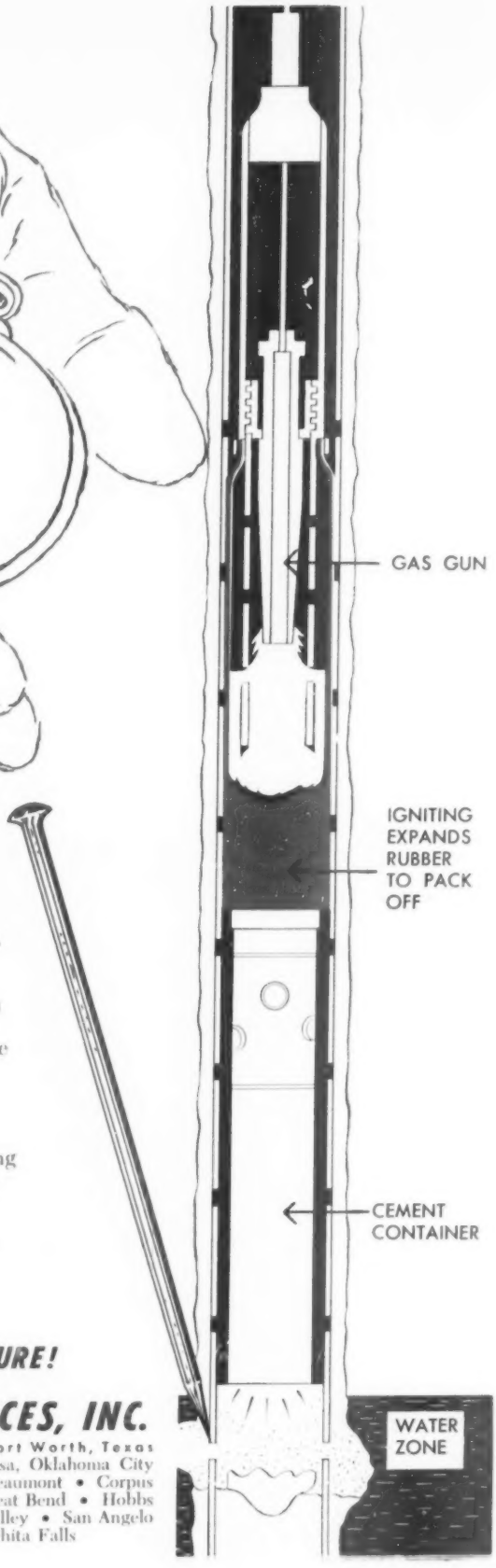
TABLE OF CONTENTS ON PAGE 1

APRIL 5, 1954

Welex

pin-point cementing *in Minutes*

with the Welex Wire Line Squeeze Cementing Tool



For water problems . . . bottom hole water, communication between zones, water infiltration of the perforations, leaky shoes, or leaky casing, the Welex Squeeze Cementer offers the maximum in efficient shutoff.

The only cement squeeze tool which can be run on a wire line, the cement is forced into place by the firing of a high pressure gas gun which expands packer against the casing as a packoff and squeezes the cement into place under higher pressure than any surface cement pump.

The packer cannot stick. It instantly releases when the cement is ejected from the tool. Plugback depth can be controlled from a minimum of one foot. Stage cementing permits economical plugbacks up to approximately 50 feet.

You save money with the Welex Squeeze Cementer by eliminating round tripping of tubing, pump truck service, cement retainers, and by using a minimum of cement. You save by getting back in production faster.

Call Welex and be SURE!

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the OIL AND GAS JOURNAL

APRIL 5, 1954 VOL. 52 NO. 48

OIL IN THE NEWS . . .

Process Prepares Reduced Crude as Cat Cracking Feed Stock	58
Rising Prices May Rule Gas Out as Petrochemical Base	59
Price Adjustment Needed to Close Gap Between Products	60
Butane Blending Seen as $100,000,000 Annual Saver for Refiners	61
Stanolind Exercises Option, Acquires Huge Gas-Synthesis Plant	62
Stepped Up Use of Middle Distillates as Diesel Fuels Possible	62
Monterey Oil Prepares to Close $52,000,000 Fullerton Deal	64
Cutback in Refining Urged to Shave Oversupply of Gasoline	66
Preview of Great Northern Plans Bypass Williston Pipeline	67
More Water-Flood Programs Proposed in Texas	68
Texas Moves to Replace Natural-Gas Gathering Tax	69
President Outlines Foreign Trade Policy to Congress	70
Congress Lines Up for Depletion Allowance Battle	70
Natural-Gas Sales Up 9.6 Per Cent Over 1952	71
Oil Basin Pipeline Co. Plans New Line In Montana	72
World Production Off Slightly in January	75
Shell Puts New Refinery on Stream in Geelong, Australia	76
Mexico Releases Figures on Country's Oil, Gas Reserves	77

TECHNOLOGY AND OPERATION . . .

[1]SPECIAL PROCESS INSTRUMENTATION SECTION	82-101
[2]Frequency-Response Analysis Holds Promise *By John E. Barber*	82
[3]Continuous Infrared Analysis of Liquid Streams *By L. W. Herscher*	87
[4]Some New Aspects of Cascade Control *By C. W. Bowden, Jr., and Harry Hartz*	92
[4]An Evaluation of Cascade Control Systems *By J. G. Ziegler*	95
[5]Evaluation of New Instruments *By W. A. Crawford*	99
When Drilling Rigs Put Out to Sea	102
Gas Storage in Depleted Oil Field	105
Lakehead Pipe Line's St. Clair River Crossing	108
When to Drill With Air and Gas	110
Unitization of Hackberry Field, Louisiana	112
Engineering Reference Section	123-132

EXPLORATION . . .

Raton . . . Frontier Exploration in Action	165
Rockies' Most Concentrated Drilling Program	166

NEWS FEATURES . . .

They Say	43
Calendar of Events	47
Journally Speaking	53
Editorial	55
This Week	57
Watching Washington	71
International News	75
Personals	79
Deaths in the Industry	81
Refining News	152
Refinery Construction Index	152
Petrochemical News	154
Natural-Gas News	156
Pipeline News	158
Exploration Statistics	185
Production Statistics	186
Refining Statistics	187
Market Statistics	188

DEPARTMENTS . . .

Books	119
Engineering Reference	123
Modern Drilling	125
Refiner's Notebook	127
Engineering Fundamentals	129
Cost-imating	132
Equipment Men in News	133-192
Pipeline Patrol (Construction)	136
Equipment Digest	147
Trade Literature	151
Active Rotary Rigs	162
Classified Advertising	189
Advertisers' Index	193

FIELDS . . .

Drilling Contractors	160
Area Field Reports	168

In Brief . . .

1. NEW IDEAS . . . Here are five instrumentation discussions on frequency-response analysis of control systems, cascade control systems, evaluation of new instruments, and continuous analysis of liquid plant streams by infrared. These articles, each authored by an expert in his particular field, present a number of new ideas and applications for the process and instrument engineer.

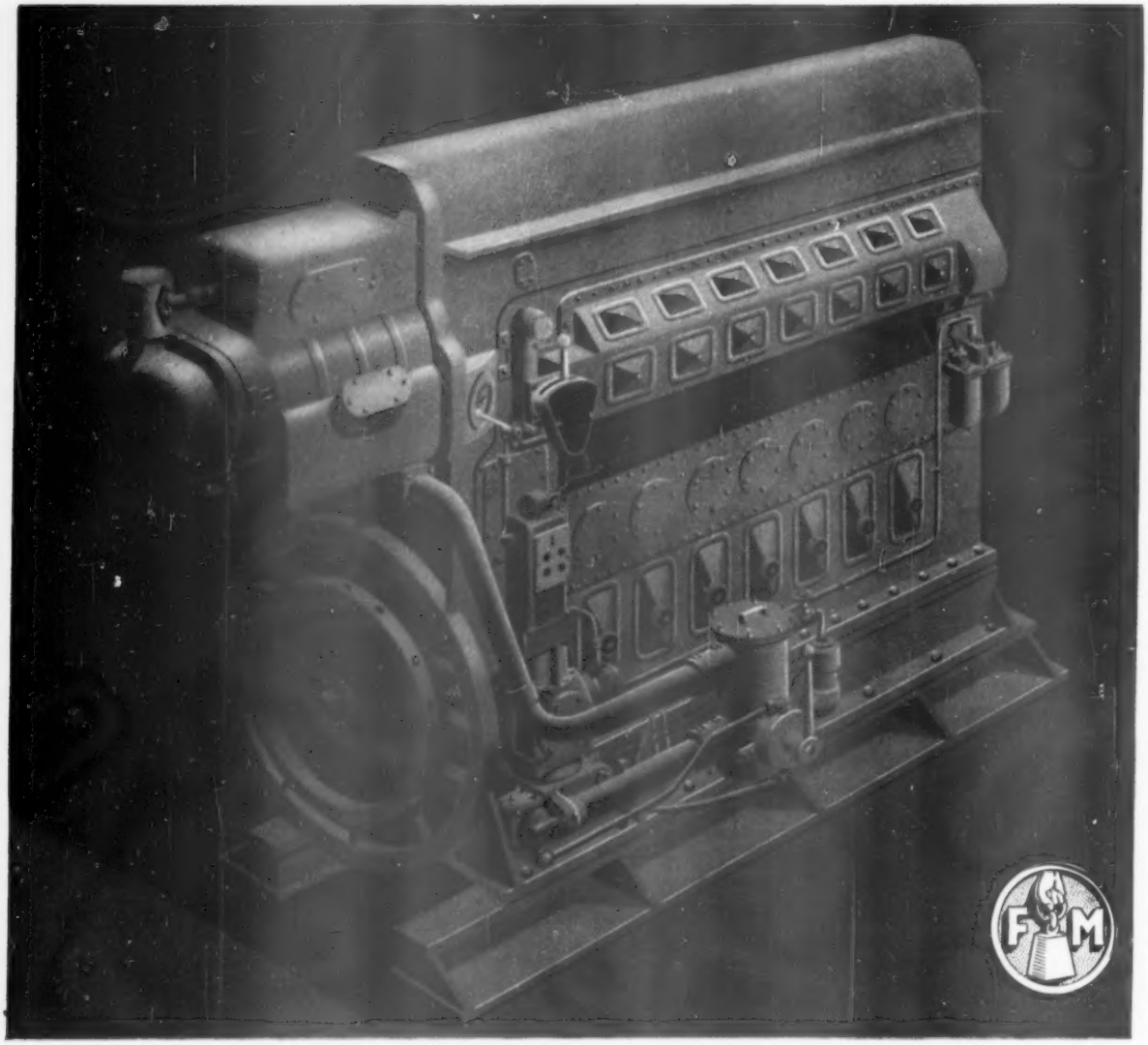
2. CONTROL ANALYSIS . . . The frequency-response method, based on the use of sinusoidal input pressures to study process equipment, holds promise of solving problems in analyzing process control systems.

Frequency-response data curves can be used to more completely describe controllers, to properly select controllers for specific jobs, and in some instances to determine instrument settings. Cataloging of frequency-response data will make possible the scientific selection of the proper controller for a given job.

3. ANALYZER GROWTH . . . The use of infrared analyzers for liquid streams should expand at such a rate as to overtake gas analyzers in the near future. This will come about partly through further adaptations of the present nondispersing instruments. Availability of spectrometer analyzers, however, will be responsible for the bulk of the expansion. At the present time there is a backlog of possible applications for liqiud stream analyzers.

4. CASCADE APPLICATIONS . . . Cascade control is a system in which two related variables are interlocked in one control loop. Prime justification for cascade control is sufficient lags in a system to prevent precision results with a single controller. Regulation of output temperature from a tube-type furnace is perhaps best single example of need for cascade control.

5. INSTRUMENT EVALUATION . . . The instrument engineer must continually review new designs and determine which of the many types of instruments are best suited to solve a multitude of problems for which complete requirements may not always be known. The two primary reasons for instrument evaluation are: (1) to determine if new equipment can do a better job than existing equipment, and (2) to determine what new jobs can be done by the new equipment that cannot be done by the existing equipment.



The Fairbanks-Morse Opposed Piston Diesel Model 38F 90. 225 to 750 horsepower. Diesel, Dual Fuel and Spark-ignition options. Other O-P engines available in horsepower ratings to 2400.

Some engines are not good enough

Yes, there are some diesels which just do not have what it takes for the job. They cannot satisfy the owner's pride in smooth, trouble-free operation and are lacking in the ability to square a balance sheet of operational costs and profits. For the more difficult jobs, many engines are simply not good enough.

Maybe you should pay more and get more!

If you want more engine-hours with fewer man-hours, *then* you should have the F-M Opposed Piston Diesel which will cost a little more and give you much, *much* more.

Fairbanks, Morse & Co., Chicago 5, Illinois.

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a name worth remembering when you want the best

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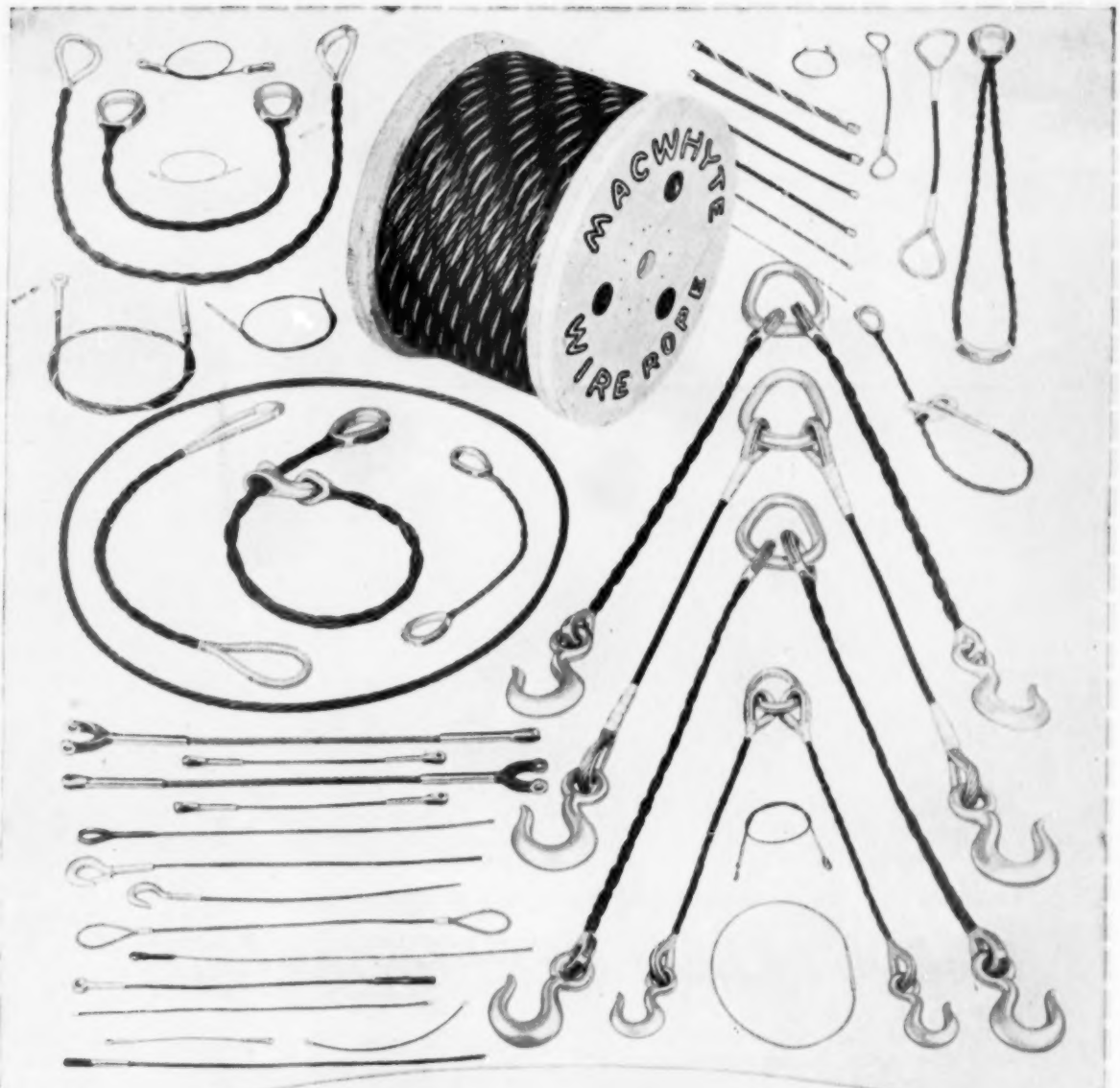

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Whatever your wire rope needs, you'll find that the best for your equipment is made by Macwhyte. A thousand and one types and sizes of wire rope are available in carbon steel, stainless steel, or monel metal. Also there are braided slings, assemblies, aircraft control cables, terminals, and tie rods.

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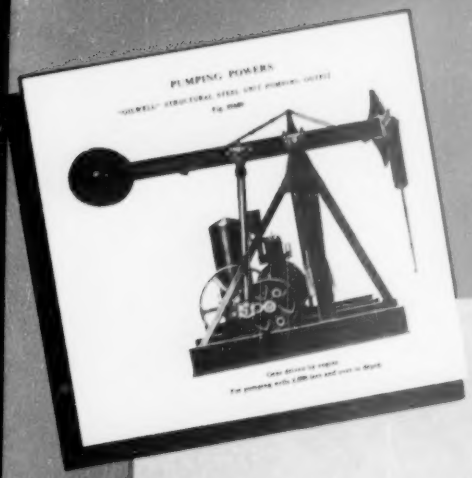
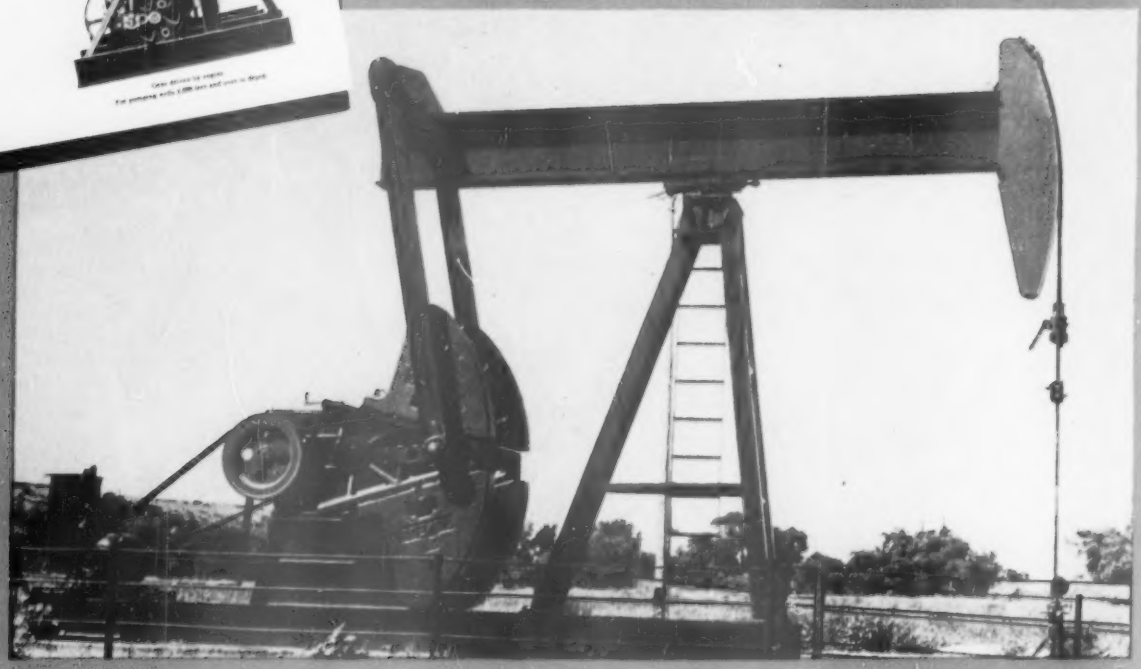


The First Gear-Driven "Oilwell" Pumping Unit

...was placed in service soon after the turn of the century



Today... its successors continue to give

UNEQUALLED PERFORMANCE!

WHAT DOES IT MEAN that "Oilwell" has devoted continuous attention to the design and manufacture of machinery and equipment for the Petroleum Industry . . . ever since it has been recognized as an industry?

It means that we are experienced and practical . . . that we know the advantages of following conservative design policies . . . and that whenever possible, improved products are kept dimensionally interchangeable with their predecessors.

And what does all this mean to present-day users of "Oilwell" Pumping Units?

It means that we are able to give our customers service throughout the later life of their pumping units . . . when service is really needed.

For example, did you know that when gear boxes on "Oilwell" units of the early 30's become worn beyond economical maintenance, present-day gears of comparable capacity can be slipped in place without so much as a change in bolt holes, pitman lengths or crank requirements?

If you have used "Oilwell" pumping units for a number of years, the value of this conservative design policy is self-evident in your own maintenance records.

If you are about to purchase new pumping equipment, investigate the many features and advantages that are combined in the "Oilwell" line . . . and know that stabilized design will enable you to secure maintenance parts and service at minimum expense throughout the long service life of each unit.

WHENEVER . . . you want help with a production problem, call our nearest store or office and discuss it with an "Oilwell" representative. He'll gladly help you get all the facts.

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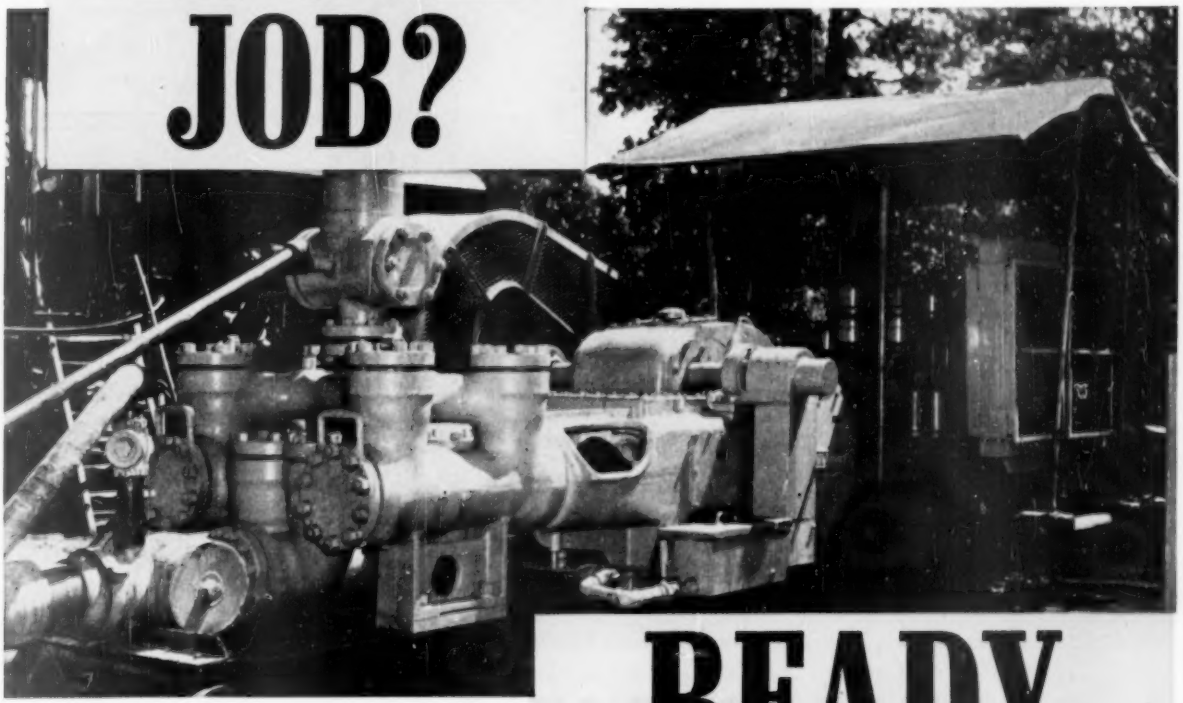
TOUGH JOB?

Bethlehem Supply Co. of Tulsa uses Link-Belt DE Roller Bearings on their No. 225 slush pump.



READY ANSWER:

LINK-BELT self-aligning roller bearings chosen for Bethlehem slush pump

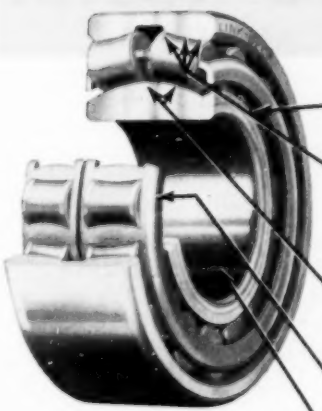
Where shafts must turn freely—day in and day out, rain or shine—you'll find Link-Belt ball and roller bearings on the job. Oil field equipment builders and users alike have learned from experience they can rely on these precision bearings for long life under the toughest conditions. For facts on the broad Link-Belt line of mounted and unmounted bearings, write for Data Book 2550. Or get in touch with the Link-Belt bearing engineer in your field.

LINK-BELT

13,458

BALL and ROLLER BEARINGS keep company with America's hardest-working equipment

LINK-BELT COMPANY: Indianapolis 6, Houston 1, Dallas 1, Los Angeles 33, Scarboro (Toronto 13); Export Office, New York 7. Distributors in All Fields.



Cutaway of Series DE Self-Aligning Roller Bearing. Link-Belt builds a complete line of mounted bearings: Pillow Blocks, Flanged, Flanged Cartridge, Cartridge, Hanger and Take-Up Blocks.

PROPER CLEARANCE of all parts is built-in, and bearing is locked together as a complete assembly.

NO PINCHING OR BINDING—Symmetrical rollers are naturally positioned by their concave shape, assuring free rolling and eliminating end friction.

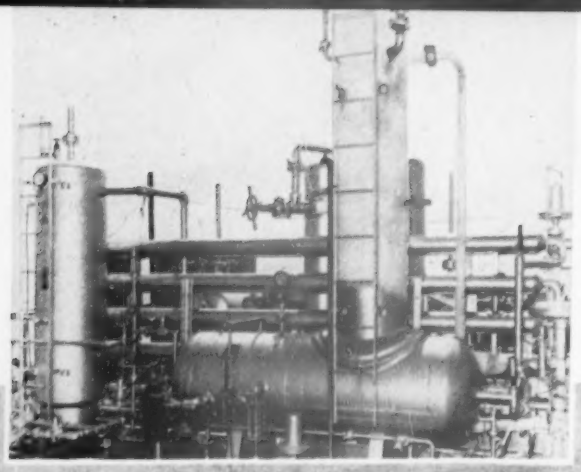
INTEGRAL SELF-ALIGNMENT — Angular contact of concave rollers operating between convex raceways. Inner raceway free to align angularly in any direction.

FULL LOAD CAPACITY for radial, thrust or combined radial-thrust loads is assured even with shaft deflection or misalignment.

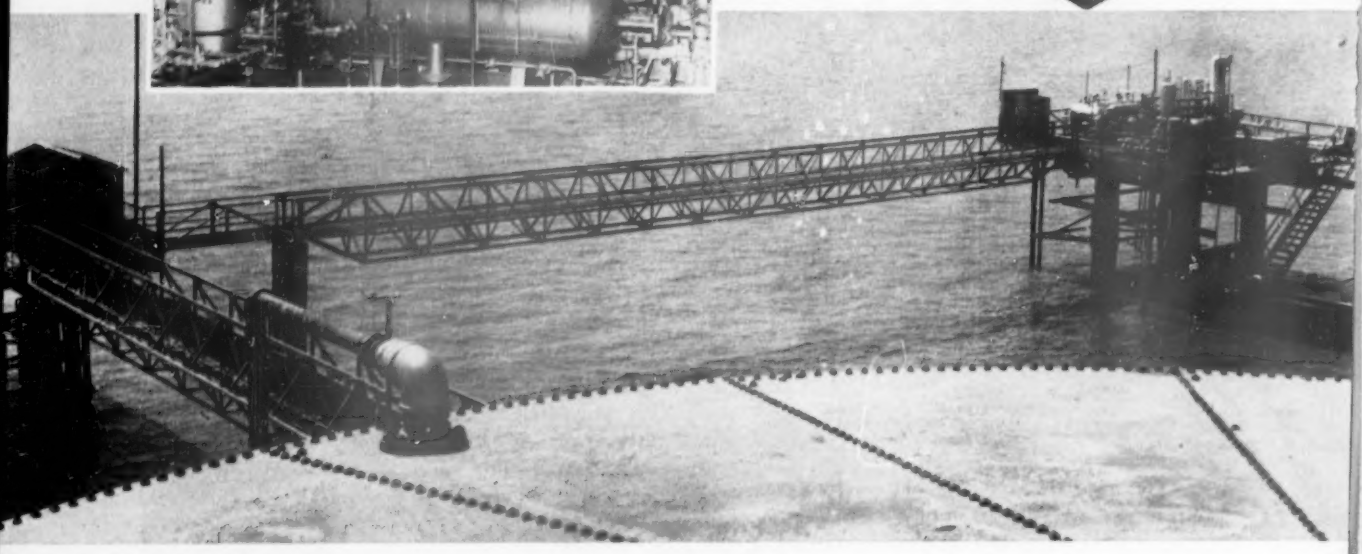
ROLLERS ARE COMPLETELY POCKETED in hardened steel retainers for accurate spacing and guiding.

STRAIGHT BORE MOUNTING for press fit direct on shafting. Tapered adapter sleeve also available for use with commercial shafting where easy removal and installation of bearings are advantageous.

The Oil and Gas Journal, published Mondays, copyright 1954, by The Petroleum Publishing Company. Entered as second-class matter September 1, 1910, at post office at Tulsa, Okla., under act of March 3, 1879. U. S. and foreign rates to the petroleum industry, $4 yearly



The extreme flexibility, dependable trouble-free performance, and high capacity of Parkersburg Hyreco Gas Processing Units is particularly advantageous in such locations as this typical off-shore installation.



COLD SEPARATION attains peak efficiency with PARKERSBURG ENGINEERED HYRECO Installations

Parkersburg engineers, specializing in cold separation, have studied the producing conditions of thousands of wells . . . have analyzed the problems of cold separation under the widest possible range of conditions.

Our experience has proved that no one type of cold separation unit can be expected to deliver top performance under all, or most, conditions. And this is why Parkersburg HYRECOS are "custom built."

When you buy a Parkersburg HYRECO you get a cold separation unit assembled to meet your own particular operating conditions. This is why, as some operators tell us, a Parkersburg HYRECO out-performs any similar type of equipment available today.

If you're ready to consider cold separation equipment, don't fail to investigate the advantages of the Parkersburg "custom built" HYRECO.

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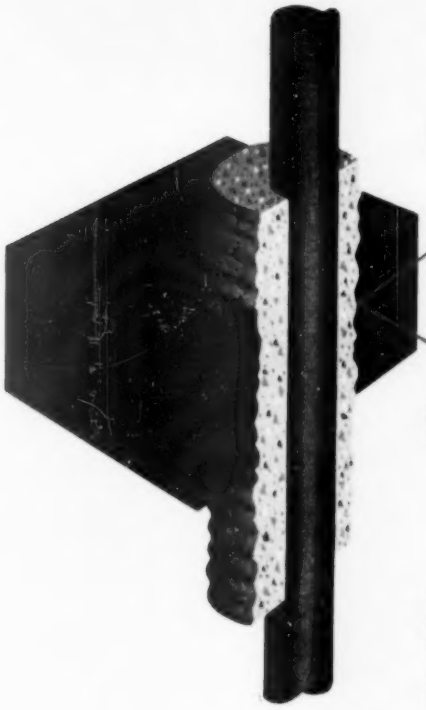

MAKES CEMENTING *RIGHT*
...FROM THE START

HALLIBURTON
ROTO WALL CLEANER

Your greatest protection against the threat of costly remedial work is an enduring cement bond between wall and casing. Cement does its job right from the start by a stronger, safer bond after cleaning filter cake with the *rotary* action of the Halliburton Roto Wall Cleaner. Only Halliburton provides this different method of horizontal scratching which allows cement to set in clean, laminated rings.

Triple rotating action which thoroughly scratches out mud cake in a full circle eliminates the dangers of vertical channeling and migration of fluid. It is this unique horizontal motion of the triple coiled cleaning spikes —44 high tensile strength spikes on each standard section—which efficiently digs into mud cake. Only one size cleaner base is required for all casing O.D. sizes, and the rugged sections of Roto Wall Cleaner can be quickly tack welded in position to suit any hole conditions.

The Halliburton Roto Wall Cleaner helps prevent a bridge off of the annulus, provides an open passageway for free flow of fluids and minimizes the hazard of sticking casing off bottom. Mud cake through porous formations is undisturbed while running casing and a better distribution of cement is possible through rotating the cleaning spikes. All these added advantages are possible only with the *rotary* action of the Halliburton Roto Wall Cleaner.

Thoroughly tested in the Halliburton laboratories, checked in the field and proved in continuing use, the Roto Wall Cleaner gives rugged protection against remedial operations. And there are many other important applications of the Roto Wall Cleaner which can help you in every cementing operation. Always use Halliburton's Roto Wall Cleaner – the most valuable low cost investment you can make. Phone your local or district Halliburton office. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON

CEMENTING EQUIPMENT

THERE'S NO SUBSTITUTE FOR EXPERIENCE IN OIL WELL CEMENTING!

WHY KRALASTIC PIPE?

HERE'S WHY!

Kralastic® resin-rubber pipe—

- **allows far easier handling and installation**
  (*Kralastic pipe can be snaked through existing lines—weighs approximately ⅛th as much as steel*)
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  (*Kralastic won't rust or rot and is an electrical insulator*)
- **offers unusually low internal friction**
  (*Kralastic's smooth surface will not accumulate scale*)
- **provides extremely high impact strength over a wide range of temperatures**
- **has excellent resistance to both bursting and collapse**
- **gives outstanding serviceability**
  (*tough, chemical resistant, and a natural insulator. Kralastic pipe should serve indefinitely*)

Pipe made of rugged Kralastic can be solvent-welded to inexpensive fittings. Or it can be easily and safely threaded for use with threaded fittings. What's more, Kralastic has high heat resistance (ASTM D648-45T, 187° F.)—with remarkable dimensional stability and lack of cold flow.

Kralastic is the *first resin-rubber to produce successful plastic pipe.* And it has continually been improved to offer advantages *no other pipe material can match.*

See why Kralastic is more and more being recognized as *the* plastic for the transport of natural gas, oil, brine, water, and hundreds of other pipe uses.

Write today to the address below and see how it can help *you.*

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HIGH MAIN-BEARING CAPACITY

One of the best-liked features of Bethlehem swivels is their main-bearing capacity, which is high in every case—high, that is, with relation to the size of the swivel. And this capacity obviously constitutes the actual rating. It is something quite different from the symbol used as the catalog number.

For instance, consider the size known as the Bethlehem 100TA. Offhand, you might think that this means a swivel rated at 100 tons—yet its main bearing capacity, at 100 rpm, is 123 tons.

The reverse situation can also be true, as you will sometimes find when comparing various brands of swivels. No matter what type you buy, it is always well to check this point—to make sure that the *actual* capacity is great enough to meet your needs.

When you investigate, start your comparisons by checking on Bethlehem swivels. You'll find they're strong, sturdy, fit for years of service. Besides high capacity, they offer an additional feature—the double-life washpipe. This is a pipe that can be locked at the top, so that the wear takes place at the bottom; or locked at the bottom so that the wear occurs at the top. Thus the wear on both washpipe and packing is divided; replacements are reduced and expensive shutdown time is held to a minimum.

Ask us about the four different sizes of Bethlehem swivels. There's one for every drilling depth, one for every job. Regardless of which you choose, you can depend upon it completely.

Bethlehem swivels are furnished in these sizes:

No.	Main bearing cap., 100 rpm
60TA	64 tons
100TA	123 tons
150TA	170 tons
300TA	302 tons

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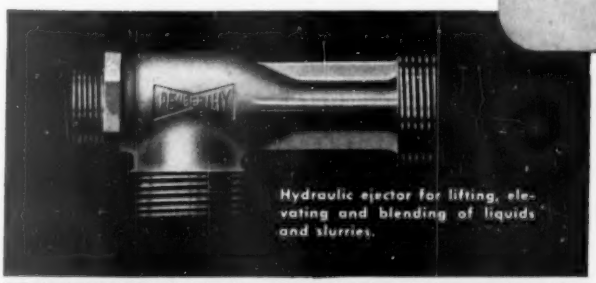
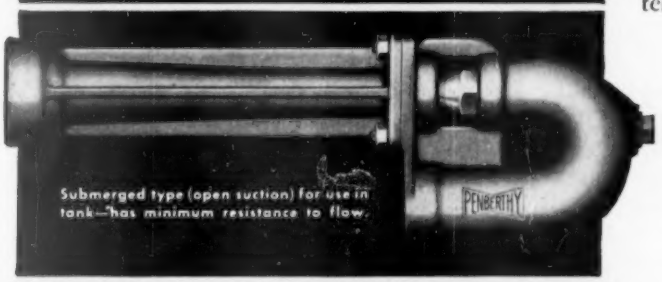
LOW COST...
COMPACT...
TROUBLE-FREE...

PENBERTHY
JET PUMPS

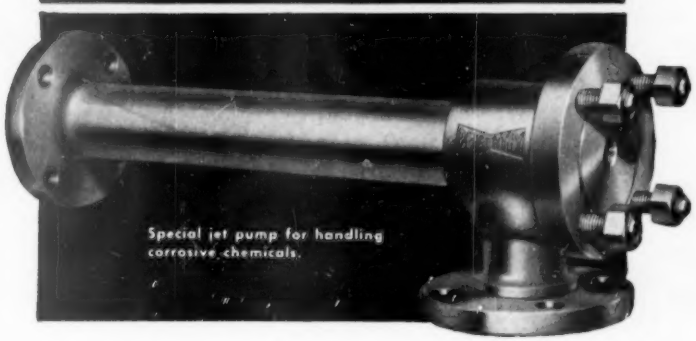


Hydraulic ejector for lifting, elevating and blending of liquids and slurries.

Steam or air operated ejector for a wide range of operating conditions.



Submerged type (open suction) for use in tank—has minimum resistance to flow.


Special jet pump for handling corrosive chemicals.

Consider the simplicity of the jet pump. It uses steam, water, air or gas under pressure to transfer or mix, without clogging, *any liquid which will flow through pipes.* It has no moving parts or packing glands. Needs no lubrication or maintenance. It's practically noiseless, costs little and is compact.

Penberthy makes a full range of jet pumps. They are being used in standard and unusual applications. Where necessary, they are made to withstand corrosion, contamination and high temperatures.

Penberthy, from wide experience, can help you save time and money, increase the efficiency of your operation. Take the first step by writing for Bulletin No. 512 which details the complete line of jet pumps by Penberthy.

★

Established 1866

PENBERTHY INJECTOR COMPANY

Division of the Buffalo-Eclipse Corporation

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- **EJECTORS**
- **INJECTORS**
- **ELECTRIC SUMP PUMPS**
- **EDUCTORS**
- **EXHAUSTERS**
- **SYPHONS**

INCREASE HYDRAULIC PUMP LIFE
REDUCE WELL PULLING FREQUENCY

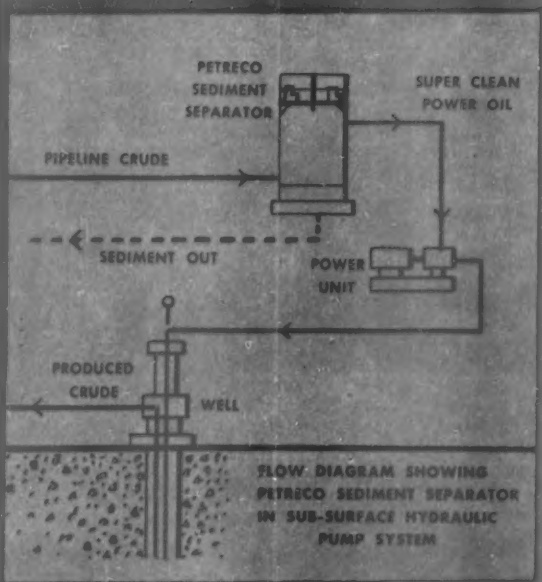
WITH THE

PETRECO *Electric* SEDIMENT SEPARATOR

Even with clean, "pipeline" oil, field tests have conclusively proved that there can be sufficient abrasive sediment in power oil to reduce the life and efficiency of sub-surface hydraulic production pumps.

The newly developed Petreco Electric Sediment Separator removes such abrasives, as well as residual moisture. It was developed primarily to improve power oil for sub-surface hydraulic pumps, although it will be equally effective in separating sediment and moisture from any oil stream wherein super-cleanliness is essential.

In one typical sub-surface hydraulic pump application, the engine end efficiencies of the sub-surface pumps were decreasing at the rate of 12% per month because of excessive abrasion. This made it necessary to change the pumps every five months, and every pump change meant a well-pulling job. After the power oil was processed in the Petreco Sediment Separator, the pumping units showed an efficiency decline of only 1% per month. *As a result, the pump change schedule was changed from once every five months to once every three years!*



FLOW DIAGRAM SHOWING PETRECO SEDIMENT SEPARATOR IN SUB-SURFACE HYDRAULIC PUMP SYSTEM

PETRECO

Electric Petroleum Treating Processes

DESALTING • DEHYDRATING • DISTILLATE TREATING
LUBE OIL TREATING • DESAPONIFICATION
SEDIMENT SEPARATION

SS 54-7

For complete information on the Petreco Sediment Separator, write or call

PETROLITE CORPORATION
PETRECO DIVISION

1390 E. Burnett Street, Long Beach 6, California
3202 So. Wayside Drive, Houston 1, Texas

Just The Right Size

Small Enough to Give You Personal Service
Big Enough to Do The Job

Many River Construction pipeline jobs are repeat contracts from companies who have used us before. These companies have found the value of doing business with our organization; we have all the equipment, the personnel, *and* the experience necessary to complete jobs of any size on schedule. Every partner of our organization averages well over twenty years of pipeline experience — your job will benefit from this "know how" when you call on River.

RIVER CONSTRUCTION CORPORATION

General Offices: 6100 CAMP BOWIE BOULEVARD, FORT WORTH, TEXAS

ROBERT THOMAS J. C. BRISCOE K. C. BIEDERMAN J. C. MINYARD

AUTOMATIC TOTALIZING of GAS FLOWS

pneumatic integrator accurately follows even rapidly varying flows

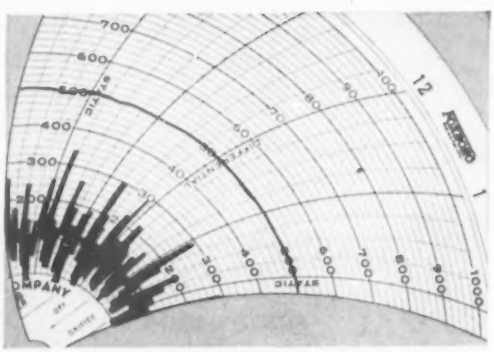
the counter reads directly in units of flow

★ *saves time and cost of planimetering*

★ *eliminates electrical hazard*

Even rapidly varying flows, often impossible to compute "by sight" or with a planimeter, are accurately totalized with the Foxboro Pneumatic Integrator. And the savings over "manual" totalizing will be enjoyed year after year, indefinitely. ' ' ' This simple and easily-maintained device, which is available on all types of Foxboro Flow Meters used in the oil fields, utilizes the flowing gas for its actuating power. Thus the hazard of electricity, or the cost and difficulty of providing a supply of compressed air, is avoided altogether. ' ' ' Many oil field operators are finding the Foxboro Pneumatic Integrator an ideal solution to their gas flow totalizing problems. It is fully described in Bulletin 394 . . . write for your copy. The Foxboro Company, 604 Neponset Avenue, Foxboro, Mass., U. S. A.

The chart record below illustrates a difficult flow pattern which the Foxboro Pneumatic Integrator is successfully totalizing.



FOXBORO
REG. U. S. PAT. OFF.
Instrumentation

1st COMMERCIAL WELL IN SOUTH DAKOTA

AXELSON RODS! AXELSON PUMP!

State "A" No. 1, first commercial discovery in South Dakota, is many miles across rugged country from the nearest supply house... even our own stores at Glendive in Montana, and Newcastle in Wyoming.

Such conditions magnify the importance of dependable pumping equipment. Logically enough, AXELSON was selected to produce State "A" No. 1. A tapered string of No. 59 rods activates a rod liner pump anchored below 8,700 feet.*

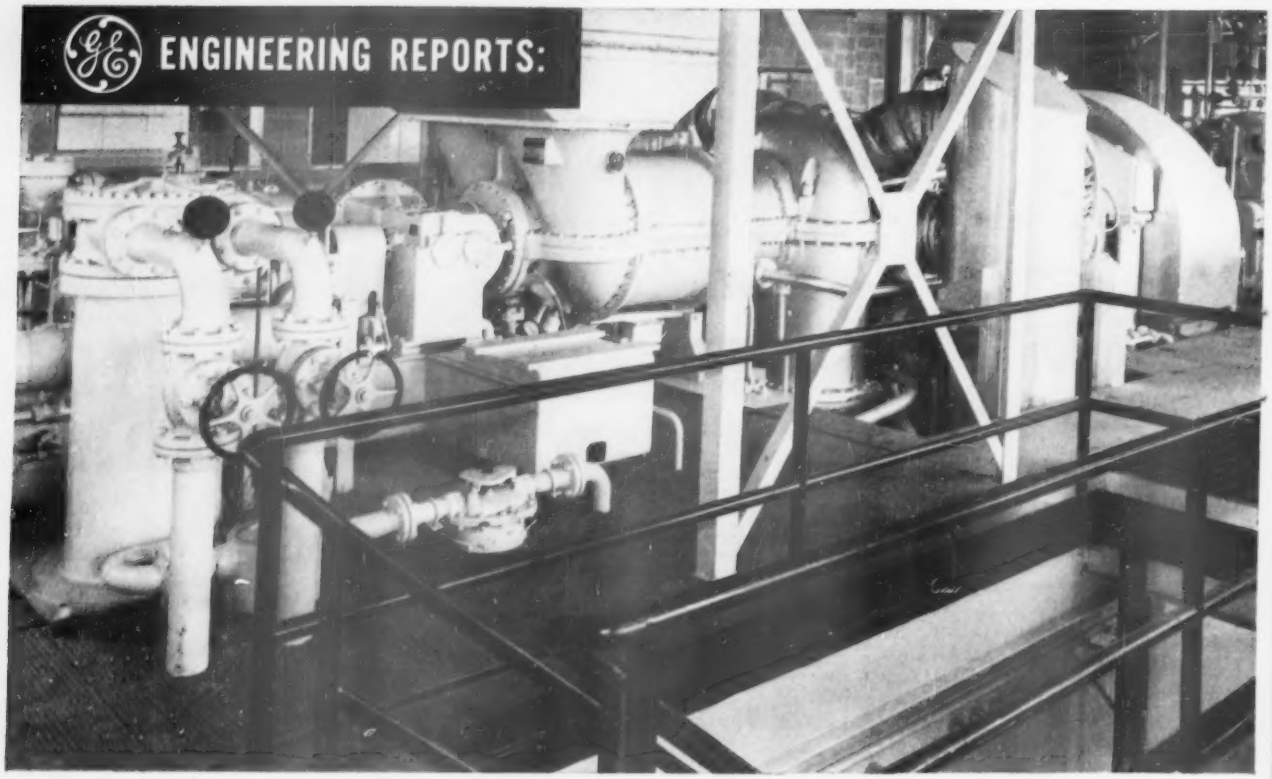
Any pumper, at any depth in any field, is a more satisfactory producer when AXELSON equipped. Ask any J&L man for specific recommendations.

J&L STEEL

Jones & Laughlin STEEL CORPORATION
SUPPLY DIVISION —— TULSA
Serving The United States and Canada

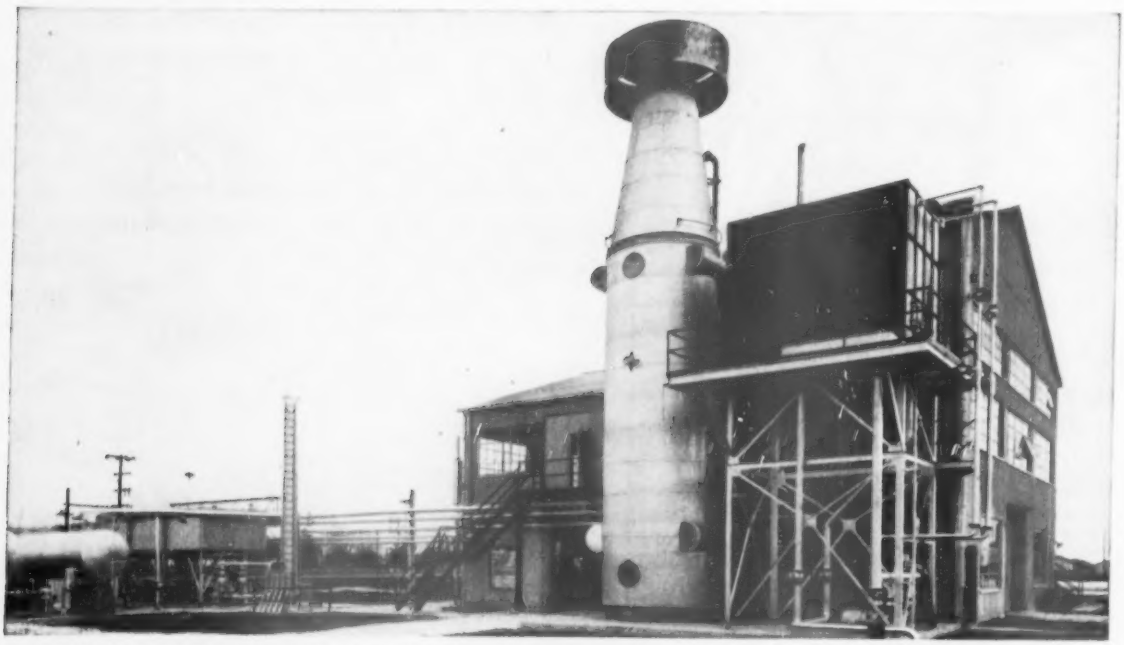
*AXELSON No. 59 Sucker Rods are made of nickel-molybdenum alloy steel, fully normalized and tempered from end to end before threading. Recommended for extra heavy loads. Strong, ductile, shock resistant.

*AXELSON Deep Well Plunger Pumps, rod liner type with stationary barrel, are ideal for deep wells where pump diameters must be reduced and rod stretch is unavoidable. Can be installed and removed without disturbing the tubing.

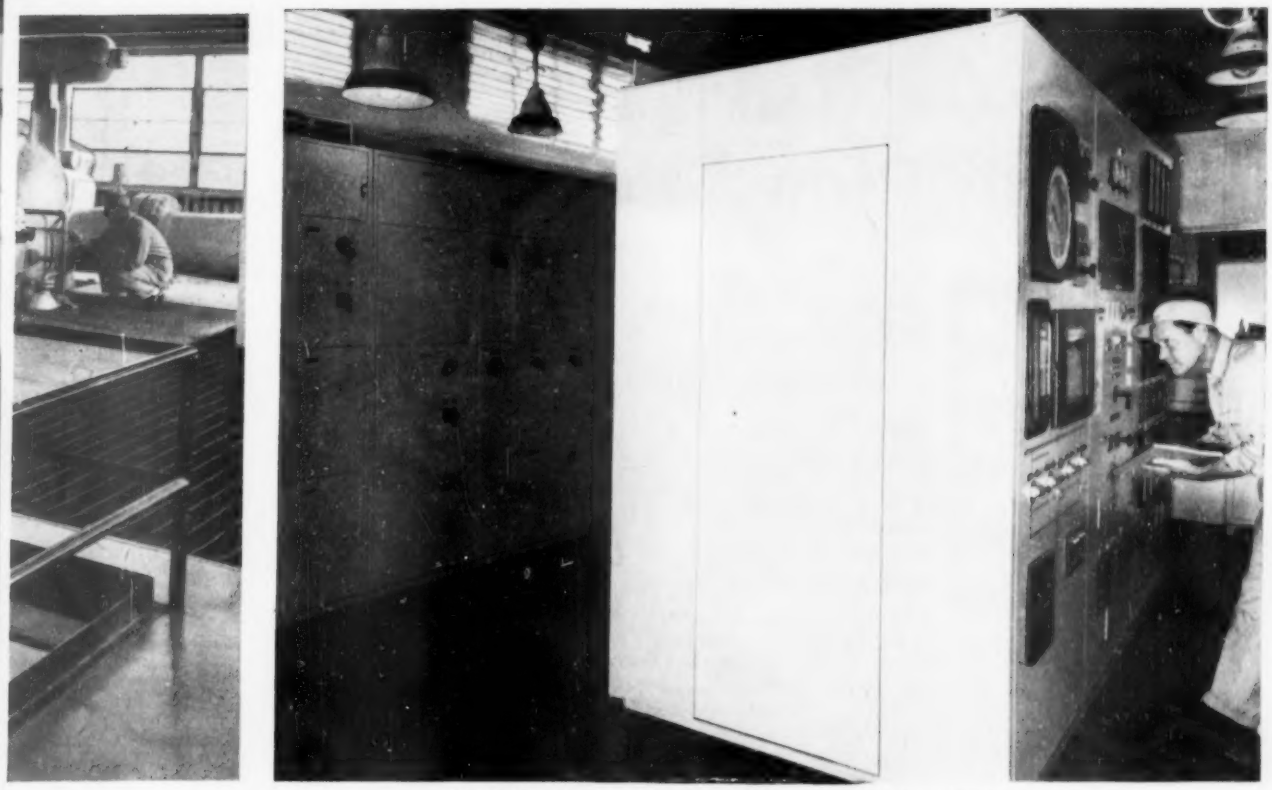


FLEXIBILITY under widely varying operating conditions is one advantage of the G-E gas turbine. It can even be operated in the desert with no cooling water required except to replace very small losses in recirculating.

G-E gas turbine helps United Gas



GREATER EFFICIENCY is provided at Napoleonville by this regenerator. Here, exhaust gases are used to heat air supply to 800 F before it enters the turbine combustion chambers to combine with the natural gas.



COMPACT, COMPLETE, CONVENIENT, the control equipment consists only of a starting and supervisory control station and an auxiliary control panel.

reach all-time day delivery peak

Pumps 510,992,000 cfd in first use of gas turbine-driven centrifugal compressor as initial main-line station

Four billion cubic feet per day of natural gas—that's the record delivery set in December, 1953 by United Gas Pipeline Co. Of this total, 510,992,000 cubic feet were pumped through United's new Napoleonville, La. station by a General Electric gas turbine.

Called in early in the planning stage, G-E engineers assisted United's engineers in the design of the main compressor building, and helped co-ordinate electric equipment with the 5700-hp gas turbine. Equipment delivery was carefully timed by G-E engineers to help complete the station on schedule. And the station has been continuously available for service since it first went on the line.

In your operation, too, a G-E gas turbine can pay big dividends.

Cuts total yearly costs. It needs fewer operators than other types of pipeline drive—only seven men are used. With few moving parts, all rotating and easily accessible, maintenance costs are low.

Provides more horsepower. It produces more horsepower in cold weather, supplying up to 25 per cent more horsepower in the winter, when demand is greatest. Rotation speed is easily changed from 2000 to 5500 rpm to meet varying load conditions. And it starts fast—in 15 minutes, automatically, at Napoleonville.

When you plan to increase gas throughput, do as United did—avail yourself early of the many specialized G-E engineering services offered through your nearest G-E Apparatus Sales representative. General Electric Company, Schenectady 5, N. Y. 660-45

Combustion Gas Turbines for the Gas Pipeline Industry—Backed by 45 years of Turbine Leadership

GENERAL ELECTRIC

Why CARLON leads in Plastic Pipe Sales!

CARLON LEADS IN RESEARCH AND DEVELOPMENT

CARLON LEADS IN QUALITY CONTROL

CARLON LEADS IN ESTABLISHING STANDARDS

CARLON GIVES A REAL GUARANTEE

CARLON WORLD'S LARGEST PRODUCER OF THE FINEST PLASTIC PIPE

Plastic is not a universal piping material . . . no plastic pipe manufacturer can claim his product will endure the punishment of all oil country installations. But we can say this: CARLON is your best buy in plastic pipe! If CARLON is utilized within the established limits of pressure and temperature, it will provide years of trouble-free service. When you specify CARLON plastic pipe, you can't go wrong.

Buy the plastic pipe that leads in sales. Specify CARLON . . . the plastic pipe that is unconditionally guaranteed.

Write today for complete information

CARLON
THE PIPE WITH THE STRIPE
1824-CP

Buy the Pipe with the Stripe!

CARLON PRODUCTS CORPORATION

Pioneers in Plastic Pipe

10201 MEECH AVE. • CLEVELAND 5, OHIO

CARLON plastic pipe is produced in Texas, Colorado, North Carolina, Ohio, Oregon and Ontario

How not to get a bang out of the oil business!

What is it that flows like a river, is invisible, drops noiselessly to the ground, and in an instant could blow a service station right out of this world—or, if properly handled, will transport you anywhere in the United States and home again?

You know the answer. It's gasoline vapor!

Do all your employees know the answer? Do all your service-station people know how to handle gasoline safely? Will all the people your company is going to hire in the next month learn how? It's pretty important that they do.

Perhaps we can help you complete this important part of their education. During the war Ethyl developed a demonstration to teach Air Force personnel the why's and wherefore's of handling gasoline safely. The show proved so help-

(Continued on next page)

ETHYL
ETHYL CORPORATION

Printed in U.S.A.

How not to get a bang out of the oil business!

(Continued from preceding page)

ful that many of our customers asked us to present it to their own people.

This we did. But soon we could not fill all the requests. So we put the Ethyl "Fire Power" demonstration on film and made prints generally available. We published the story in vivid comic books, and offered them in quantity to any refiner.

To give you some idea of how useful this film has been to the industry, in the last 3 years more than 133,000 people have seen it. And we've distributed several million copies of the "Fire Power" booklet.

We're particularly proud of the Ethyl "Fire Power" program because of the part it plays in helping our customers keep the oil industry one of America's safest places to work.

ETHYL CORPORATION
NEW YORK 17, NEW YORK

WORTH NOTING

Desert temperatures are maintained year-in, year-out in a room at the Ethyl Research Laboratories in Detroit as part of a continuous study of gasoline stability during storage.

The official American football field is 100 yards long. If all the sodium cells at Ethyl's Baton Rouge plant were lined up, they would reach the length of five football fields. This is the largest sodium plant in the world!

The work of Ethyl's automotive engineers in the field is backed up by the experience of more than 100,000,000 research miles rolled up during road-test programs.

Ethyl Service is backed by 31 years of antiknock experience

whatever you order from Claymont

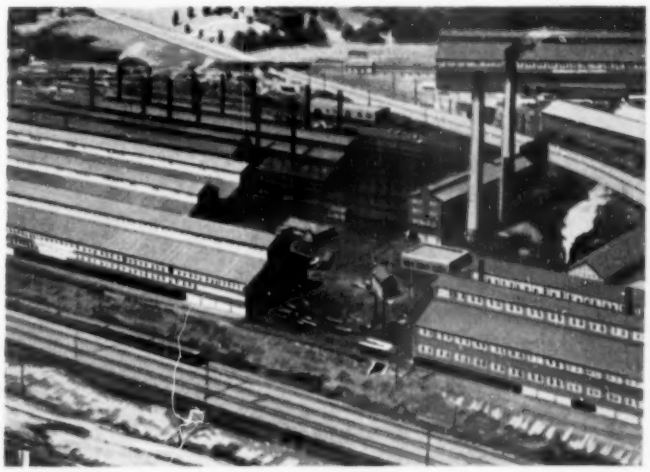
ALLOY AND CARBON
STEEL PLATES

STAINLESS-CLAD PLATES

FLANGED AND DISHED HEADS

MANHOLE FITTINGS AND COVERS

LARGE DIAMETER
WELDED STEEL PIPE



shipped the way you want it . . .

MAIN LINE RAIL SERVICE

SEA OR INLAND WATERWAY

OVER-THE-ROAD TRUCK
TRANSPORT

Delaware Valley, U.S.A. It's the home of Claymont Steel—America's fastest-growing industrial area and one that boasts unsurpassed transportation facilities for both shipper and buyer.

That's why the products of our open hearths, rolling mills, flanging shops and pipe mill can be shipped to you via transportation that is most advantageous for you.

Let us know your requirements. Our location in the heart of the Delaware Valley means that we are most favorably situated to economically and efficiently serve your needs for steel and steel products. Get in touch with our nearest District Office or our General Sales Office in Wilmington, Delaware.

Claymont Steel Products

CF&I

PRODUCTS OF WICKWIRE SPENCER STEEL DIVISION • THE COLORADO FUEL AND IRON CORPORATION

2214

ABILENE • ALBUQUERQUE • AMARILLO • ATLANTA • BOISE • BOSTON • BUFFALO • BUTTE • CASPER • CHICAGO • DENVER • DETROIT • EL PASO • FT. WORTH
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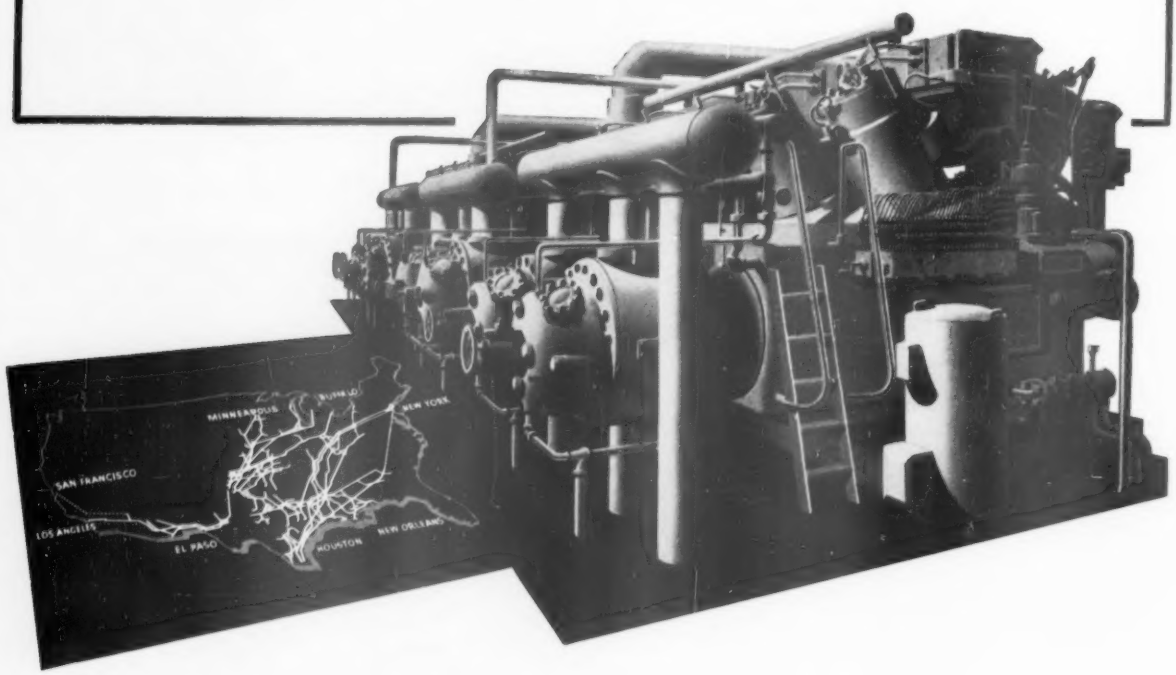
SALT LAKE CITY • SAN FRANCISCO • SEATTLE • SPOKANE • TULSA • WICHITA • *Canadian Representatives At* • EDMONTON • TORONTO • VANCOUVER • WINNIPEG

GULF SECURITY OIL

provides better lubrication
for pipe line compressor units,
helps prevent operating troubles



Here's the lubricant you can depend on to help keep your pumping stations operating smoothly and continuously—Gulf Security Oil. It provides effective protection for cylinders and bearings in both engines and compressors.

Because of its excellent resistance to oxidation, Gulf Security Oil stands up for many hundreds of hours without any appreciable change in its original properties. After years of operation with this quality lubricant, equipment shows remarkable freedom from cylinder wear and a minimum of carbon deposits on valves and rings. And because oil control rings are kept clean, oil consumption is remarkably low.

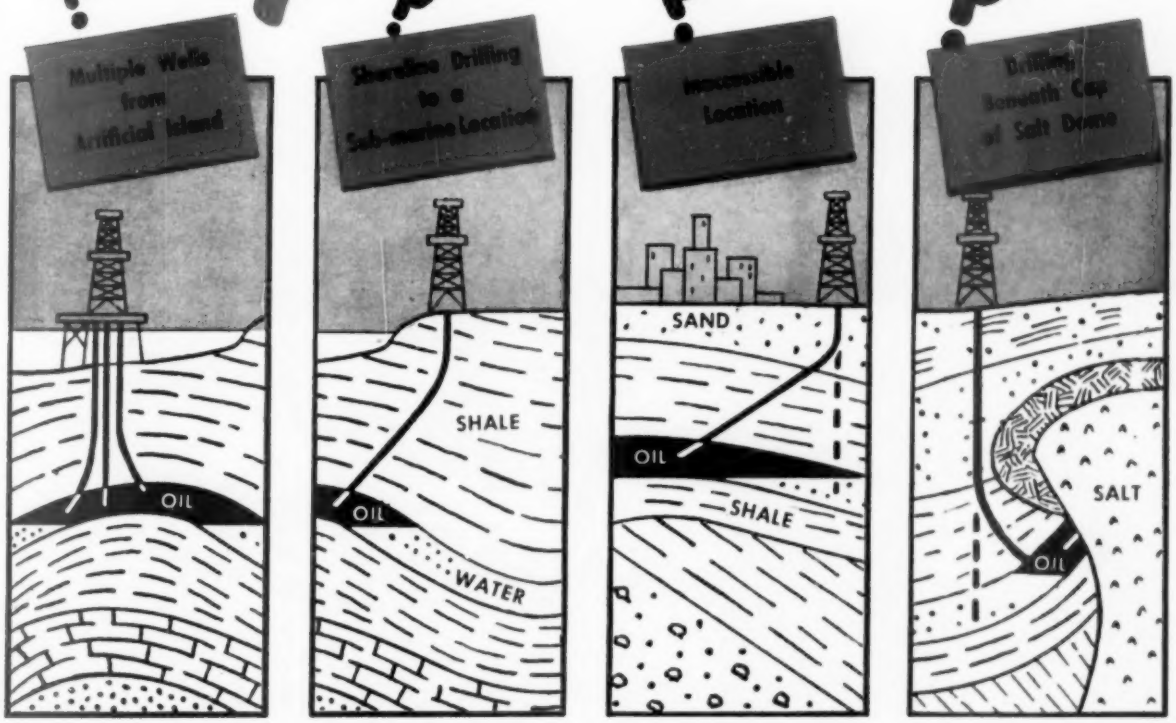
Operators of the many units lubricated with Gulf Security Oil report that this quality lubricant helps them get more operating hours between overhauls, and avoid unscheduled shutdowns.

For additional information on Gulf Security Oil and for the services of a Gulf Sales Engineer, get in touch with your nearest Gulf office today. Write, wire, or phone.

Gulf Oil Corporation · Gulf Refining Company,
Pittsburgh 30, Pennsylvania.

GULF INDUSTRIAL LUBRICATION

You Name the Problem —



Eastman will SOLVE it!

Above are four different and difficult drilling problems which can be solved by directional drilling.

If you have a similar situation, Eastman can and will assist you.

This company originated Controlled Directional Drilling service 23 years ago. Eastman's extensive experience in solving these types of problems in oil fields throughout the world has made them the leaders in Controlled Directional Drilling.

Call your nearest Eastman office for additional engineering information.

Originators of Controlled Directional Drilling Service
Pioneers of Oil-Well Surveying

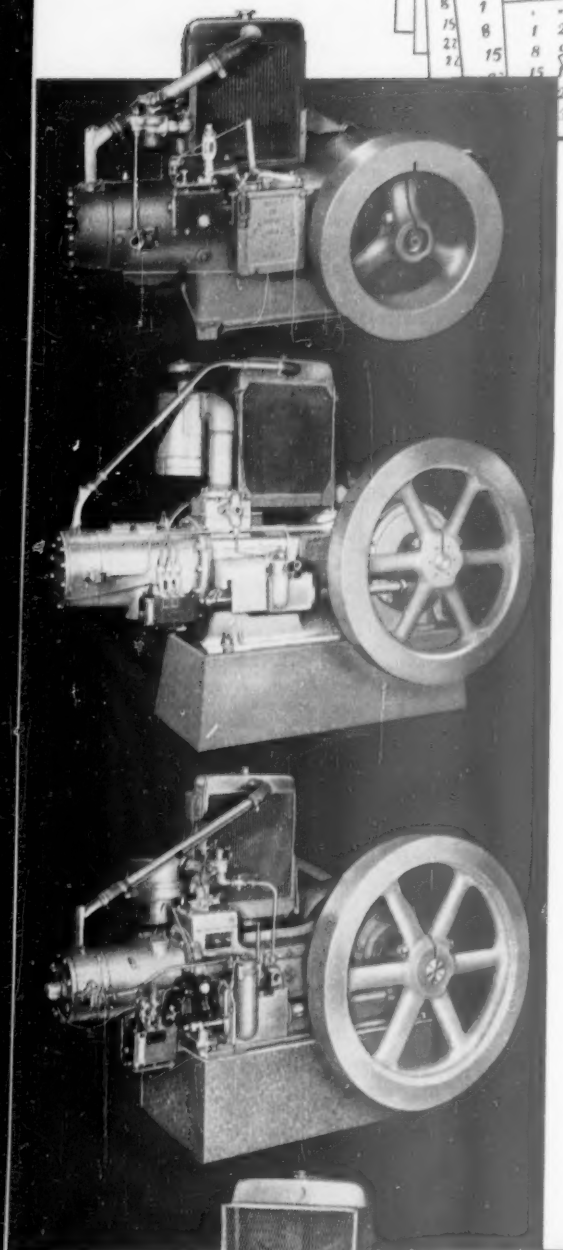
26 OFFICES FOR YOUR CONVENIENCE
CONSULT YOUR TELEPHONE DIRECTORY

SEE OUR CATALOG IN THE COMPOSITE CATALOG

EASTMAN OIL WELL SURVEY COMPANY

LONG BEACH DENVER HOUSTON

Export Sales and Service
EASTMAN INTERNATIONAL COMPANY ★ P. O. Box 1500 • Denver, Colorado



Engines that run by the year!

Your sturdy AJAX Engine—turning steadily, powerfully, smoothly under load—will maintain its pace by the month and year with little attention and even some neglect thrown in!

That's because AJAX is an *oilfield* engine all the way. It is built for seldom-visited operation in remote leases, as well as right under your thumb—glad of an annual oil change if you'll be so good, and requiring an on-location overhaul only at very long intervals.

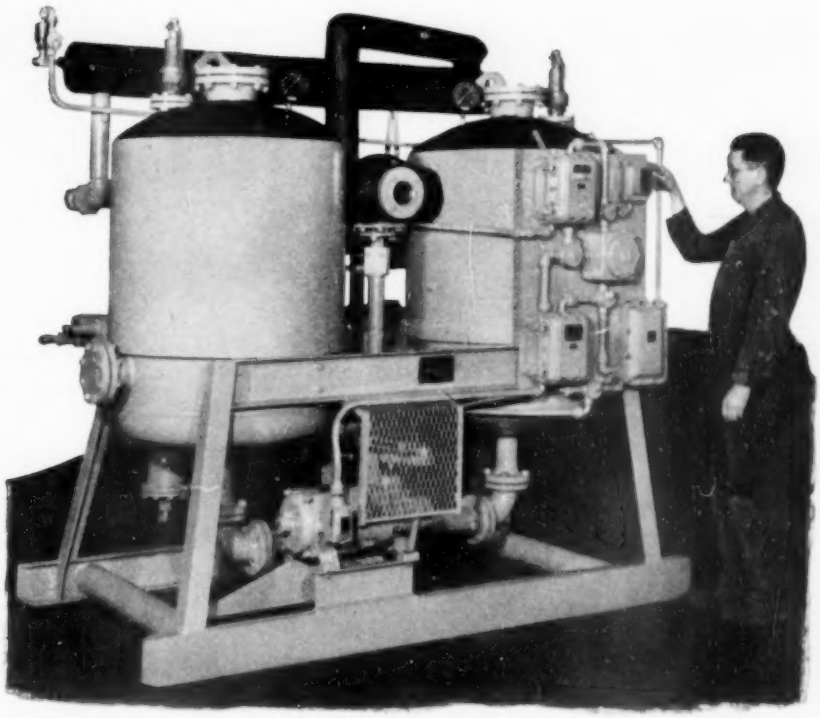
Any model AJAX will work like that for you. And you've got the industry's only COMPLETE LINE to choose from. Write us for descriptive bulletins—and see your Supply Man for a full discussion of your needs.

Gas and Oil Engines

Builders of GAS AND OIL ENGINES, PRESSURE PUMPS,
STEAM DRILLING ENGINES, INDUSTRIAL STEAM ENGINES

CORRY, PENNSYLVANIA

Oil Field Distributors: THE NATIONAL SUPPLY CO., PITTSBURGH, PA.
R. B. MOORE SUPPLY CO., BOLIVAR, N.Y. • BETHLEHEM SUPPLY CO., TULSA, OKLAHOMA



Fully automatic instrument air dryer . . . BY-type Lectrodryer

DRY AIR and how to get it...

Even on the most arid desert, air is wet! Elsewhere, it's wetter. Hence, if you need dry air, you must use machinery to get it.

A Lectrodryer* is an air drying machine. With it you can dry great volumes of air in a continuous flow to prescribed low dewpoints. You can reduce the moisture content of air to a stable constant!

Lectrodryer machines can drop air to dewpoints below −100°F . . . reduce relative humidity below 10%.

There's probably a Lectrodryer already built that meets your drying need. The largest (for a wind tunnel) dries three tons of air per minute to a dewpoint of −70° F. Smaller machines are preserving the interior of Navy ships of the "Mothball Fleet" by maintaining a constant relative humidity below 30%.

Besides air drying, there are Lectrodryers that dry many gases and organic liquids, handling pressures as high as 6000 psi.

If you use air, give some thought to drying it with a Lectrodryer. Write for *Because Moisture Isn't Pink,* a booklet describing Lectrodryers and how industries have used them. Request also, *The Moisture In Our Atmosphere,* a technical booklet on the nature, behavior and measurement of water vapor. Both are free! Pittsburgh Lectrodryer Corporation, 325 32nd Street, Pittsburgh 30, Pa.

LABORATORY LECTRODRYER

If your experimentation requires small quantities of dry air or other gases, a Laboratory Lectrodryer will help you greatly. Rated at 100 cubic feet per hour, these machines have in many cases provided the dryness in research that has led to large savings in production.

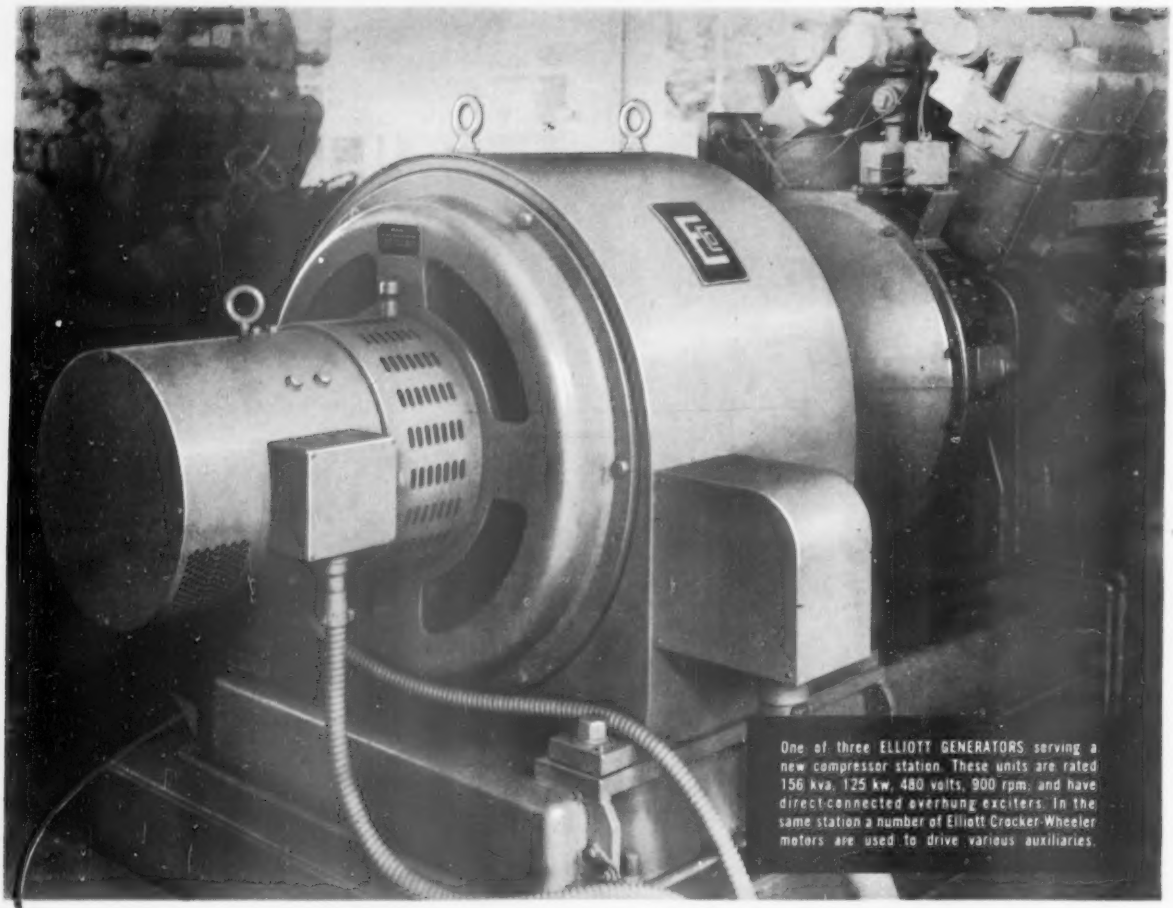
$155.00 F.O.B. Pittsburgh

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U.S. PAT. OFF.



One of three ELLIOTT GENERATORS serving a new compressor station. These units are rated 156 kva, 125 kw, 480 volts, 900 rpm, and have direct-connected overhung exciters. In the same station a number of Elliott Crocker-Wheeler motors are used to drive various auxiliaries.

FOR PIPE LINE STATIONS THAT MAKE THEIR OWN POWER

ELLIOTT GENERATORS

Provide —

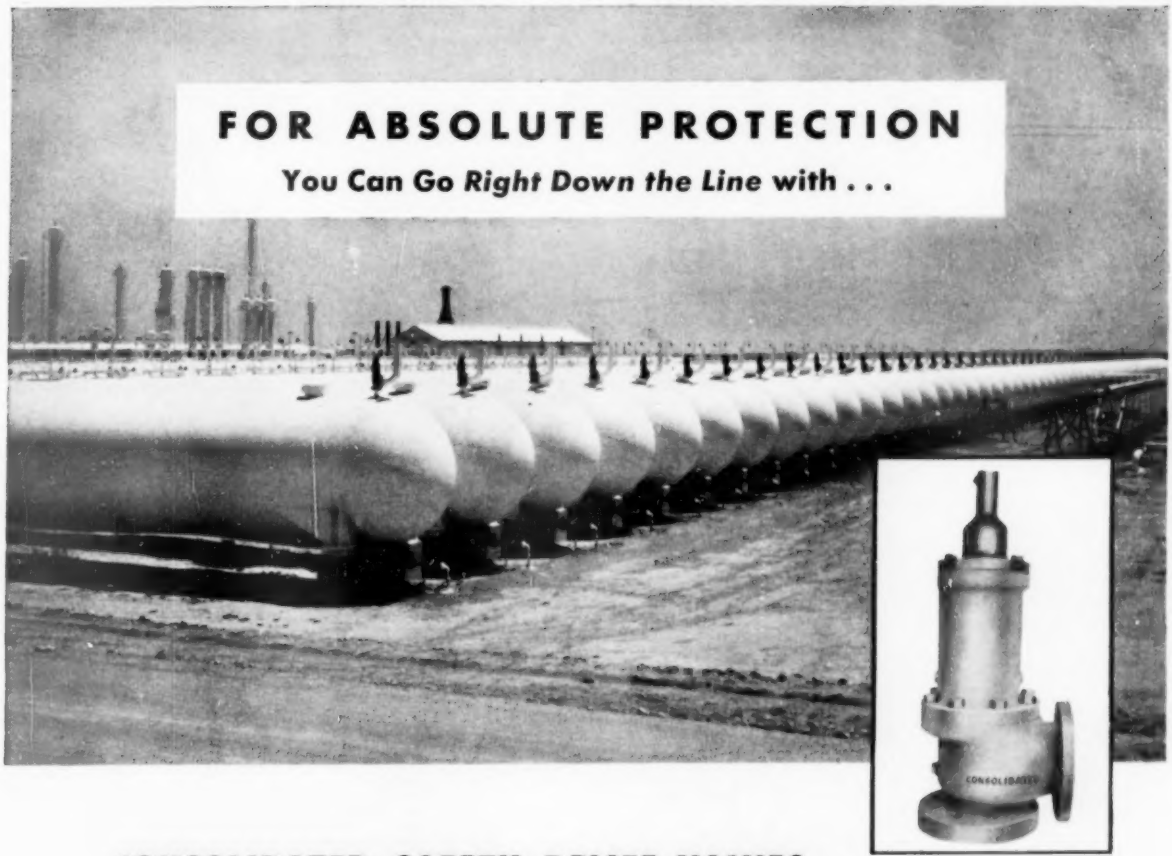
1. *Reliable* electrical energy for installations not conveniently located near electrical power systems.
2. *Economical* generation with fuel available at the site.
3. *Convenient* operation and maintenance with available plant operating personnel.

For full details on Elliott generators particularly adapted to this type of service, see your local Elliott representative or write Elliott Company, Ridgway, Pa.

ELLIOTT Company

R3-3

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS



CONSOLIDATED SAFETY RELIEF VALVES

COMPLETE PROTECTION for personnel, property and equipment rates top priority in safety engineering wherever industry must confine gases, vapors and liquids in unfired pressure vessels. That is why Consolidated Safety Relief Valves are such a common sight on processing facilities, pipelines, pumps and storage tanks.

Consolidated Safety Relief Valves incorporate design and construction features that assure *dependable tightness* under the severest discharge piping stresses. Unfired pressure vessels are absolutely safeguarded against overpressures. No matter how tough the conditions of use, you can be sure of continuously reliable performance at the rated capacity.

SIMPLE DESIGN — 25% fewer parts than ordinary safety valves — means that Consolidated Safety Relief Valves minimize maintenance and standardization problems and save in long-life operation.

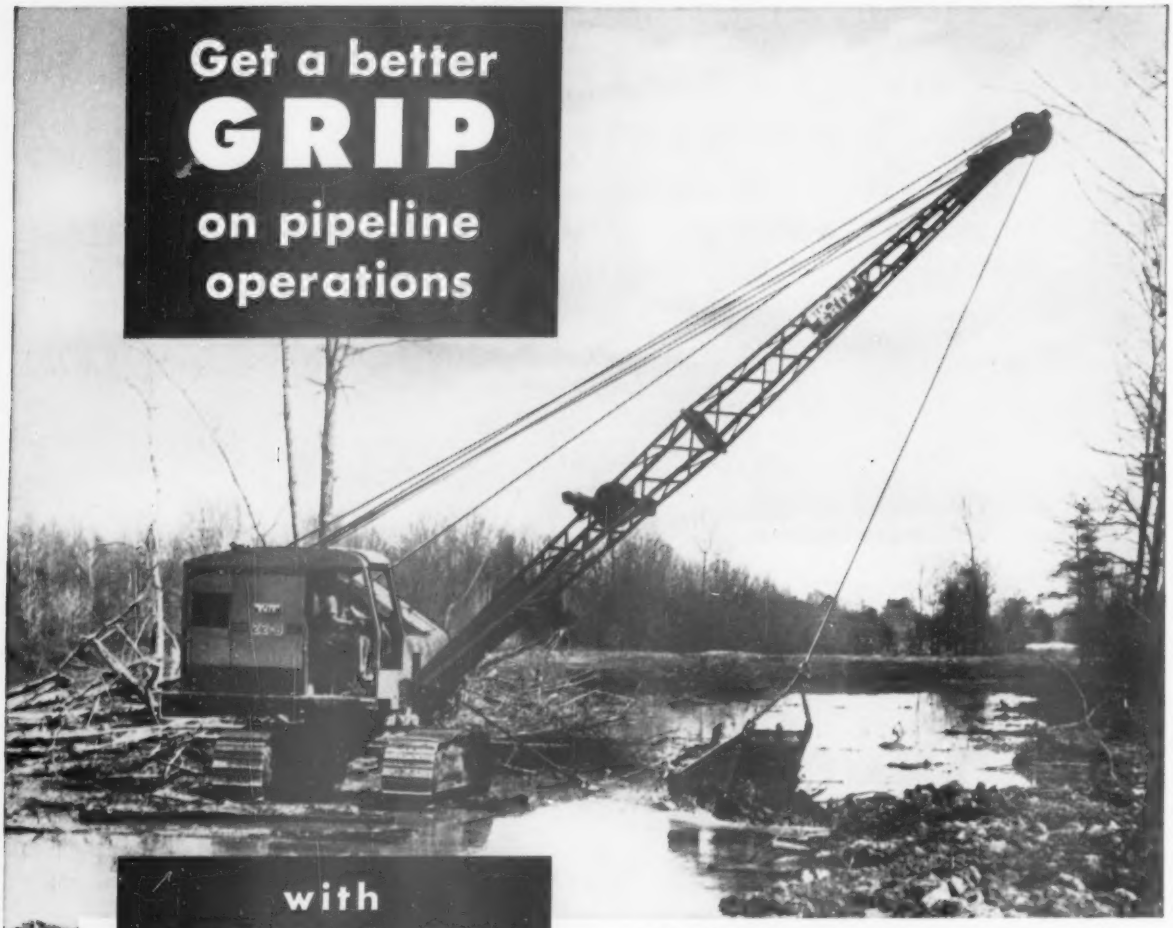
Write for complete information.

CONSOLIDATED SAFETY RELIEF VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** TULSA, OKLAHOMA

MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

Get a better GRIP on pipeline operations



This 22-B dragline equipped with tractor-type crawlers is backfilling a submerged pipeline trench in northeastern Texas.

with BUCYRUS-ERIE TRACTOR-TREAD EXCAVATORS

Now, big yardage Bucyrus-Erie 15-B and 22-B excavators are offered with advance design tractor-type crawlers. And these sure-gripping treads are putting the bite on pipeline costs wherever they work. Here's why:

Mobility Across country, over rough terrain, in swamps and creek beds, up banks and high hills — whatever the terrain these new treads give the 15-B and 22-B machines the footing to keep rolling — even up grades as steep as 35 percent.

Strength Back of the new tractor-type crawler is more than ten years of design and field testing. It's a modern, heavy duty tread with big, strong parts that keep going longer on punishing pipeline duty.

Mud No Problem Extra long recoil spring takes the added tension when mud jams into the treads. Open design retards caking of rollers with mud. In addition high axle clearance keeps propelling machinery up and away from mud. Positive seals protect all bearings from dust and grit.

Easier lubrication Lubricated with oil instead of grease, these crawler treads are easier to maintain. Pressure lubrication forces old oil and sediment out of bearings, assuring longer life.

Ask your Bucyrus-Erie distributor for complete information on a 15-B or 22-B dragshovel or dragline equipped with tractor type crawlers. The facts will speak for themselves.

34E53

BUCYRUS ERIE

BUCYRUS-ERIE COMPANY • South Milwaukee, Wisconsin

PHOTO COURTESY STEWART & STEVENSON SERVICES, INC., HOUSTON, TEXAS

quad power unit extends advantages of **CHRYSLER** *Performance and Economy to new fields*

Here's Chrysler Power at work in the South Texas oil fields. This time it is four Chrysler Model 20 Industrial V-8 Engines working together as a single unit in a Stewart & Stevenson Quad Power Unit, in turn driving a mud pump. This particular Quad has supplied mud pump power for the drilling of ten oil wells in the eight months it has been in use.

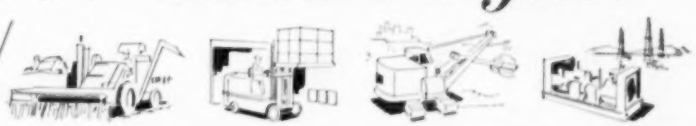
You see Stewart & Stevenson Quads in other fields, too, but nowhere do they encounter tougher jobs than pumping mud—or more important jobs either. The continued flow of mud down the hole being drilled is absolutely necessary if drilling is to continue uninterrupted. That's because mud serves several very important functions: it lubricates the drill bit, it removes bit cuttings, it seals the walls of the hole and it provides weight to prevent blowouts.

Pumping mud requires great power on a continuous basis, power that can "roll" with the heavy pulsating motion of the pump. The 331 cubic inch displacement Model 20 Engine is ideal for a multiple-engine installation. It meets the demand for high horsepower. It is a compact engine, easy to install, low in initial cost, and economical to operate and maintain. Parts are readily available, and at a fraction of the cost of competitive equipment. Each engine is supplied with a Chrysler gyrol Fluid Coupling which absorbs shock loading, thereby enabling smooth transmission of power from all four engines to the common power output shaft. One or more of the engines can be clutched out if less than maximum power is required.

Check your power needs with a Chrysler Industrial Engine Dealer. Ask him about optional equipment too. Remember, Chrysler Power is not expensive. Production-line methods adapted to specialized industrial engine building provide a custom-built engine at mass-production prices. If you prefer, write: ***Dept. 144, Industrial Engine Division, Chrysler Corporation, Trenton, Michigan.***

CHRYSLER *Industrial Engines*

HORSEPOWER WITH A PEDIGREE



AGRICULTURE • INDUSTRY • CONSTRUCTION • OIL FIELDS

Typical BS&B COLD-FRAC* System With Hydrate Inhibitor in service on gas condensate well production.

LOW TEMPERATURE BS&B SEPARATION

COLD-FRAC* SYSTEM

Which Type Is The Right One For YOUR Conditions?

Wherever there is the problem of separating natural gas from its condensable fractions at low temperatures . . . and of stabilizing or fractionating the recovered condensate to specification product . . . there is a correct type of BS&B COLD-FRAC System to do the job! Any combination of conditions can be handled efficiently by one of these units:*

3 Types For Gas Condensate Well Production!

1 COLD-FRAC* System Without Hydrate Inhibitor. After free water is removed, high pressure gas is expanded into a special separator where hydrates are formed and melted. This system is necessarily limited to operation above the hydrate-formation temperature up to the point of expansion, and can therefore be used only where high pressure drops are available.

2 COLD-FRAC* System With Hydrate Inhibitor. Allows the use of regenerative heat exchange, making it applicable to a wider variety of situations because less expansion is required to achieve maximum recovery.

3 COLD-FRAC* System With Hydrate Inhibitor And Mechanical Refrigeration. Where declining wellhead pressures have limited the separator temperatures to the point where maximum recovery cannot be realized, mechanical refrigeration is added to supplement available natural refrigeration.

2 Types For Lease-Located Gasoline Plants!

1 COLD-FRAC* System With Hydrate Inhibitor And Natural Refrigeration. Applicable to high pressure, high gas-oil ratio oil wells. Uses the same principle of expansion refrigeration that is applied to gas condensate well production. Condensables are fractionated to produce specification natural gasoline and LPG products.

2 COLD-FRAC* System With Hydrate Inhibitor and Mechanical Refrigeration. Used for processing the casing-head gas that is separated from low pressure oil well production. Mechanical refrigeration is used to reduce temperatures to a point where condensables can be separated.

* "COLD-FRAC" is a trade-mark of Black, Sivalls & Bryson, Inc. (Patented and patents applied for)

The name to remember in Low Temperature Separation is — COLD-FRAC! By BS&B.*

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY

BLACK, SIVALLS & BRYSON, INC.
Oil & Gas Equipment Division — Dept. 1-A4
1708 West Main Street Oklahoma City, Oklahoma

AVAILABLE JOHNSTON by AL CAPP

IS YO' AVAILABLE JOHNSTON?
YAS'M—AH IS AVAILABLE—BUT STRICTLY FO' TESTIN' OIL WELLS, PRACTIC'LY ANYWHAR!!—AN' BY TH' TIME TH' PIPE IS PULLED!! US JOHNSTONS HAS 73 SERVICE OFFICES!!
DOES YO' WORK FAST?
YAS'M!!—BUT STRICTLY IN MAKIN' TESTS WIF A MINNY-MUM OF LOST DOWN TIME!!
DON'T YO' TEST ANY-THING BUT OIL WELLS?
NOPE!! —THASS OUR SPESHULTY!! —THASS WHY WE USUALLY GITS A SAFE, ACCURATE TEST, TH' FIRST TIME!!
al Capp

C-541

Copr. Capp Enterprises, Inc. 1954.

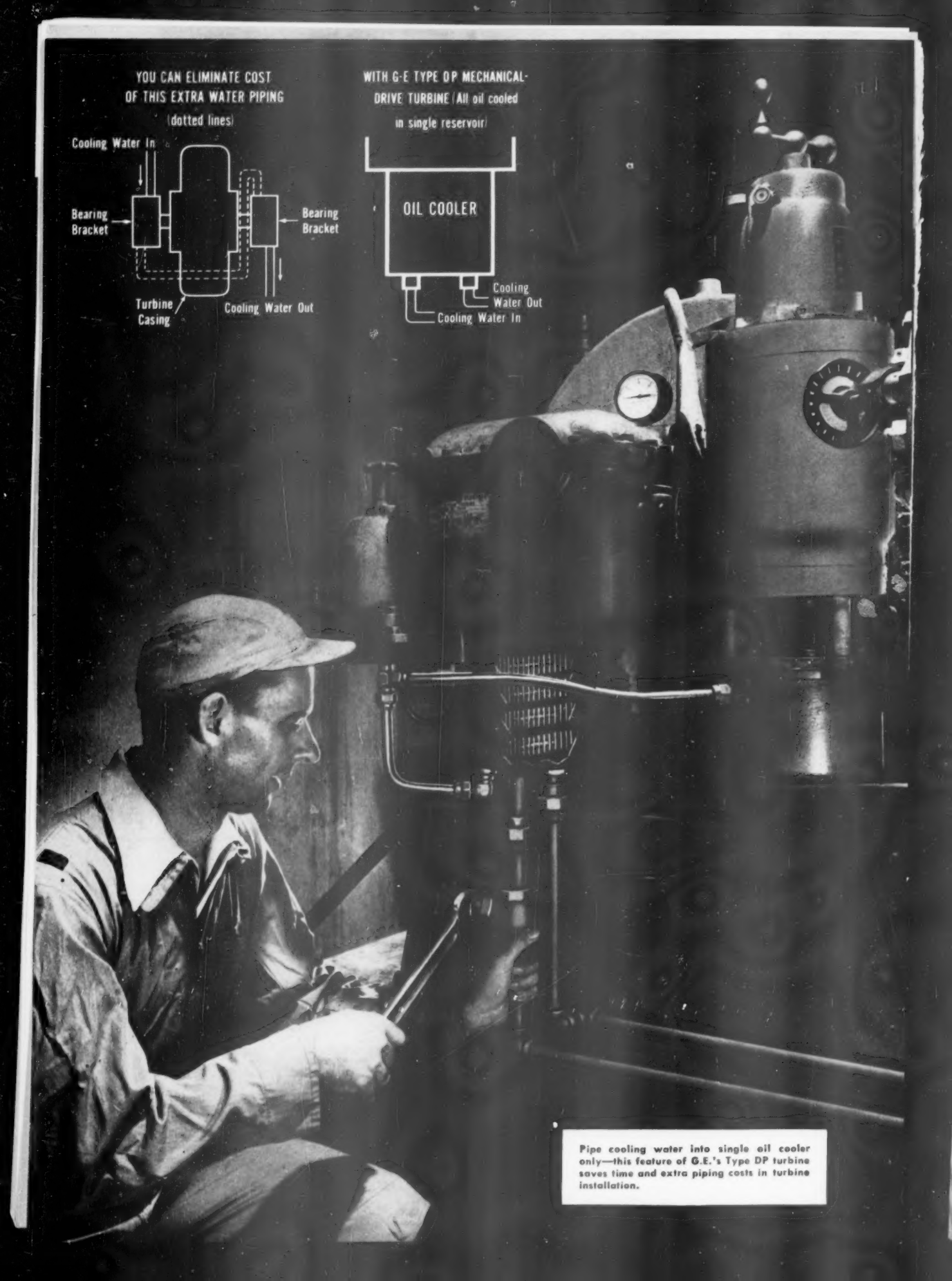
JOHNSTON TESTERS

first in drill stem testing

HOUSTON, TEXAS

LOS ANGELES, CALIF. • CALGARY, CAN.

FORMATION AND CASING TESTING — JOHNSTON



Pipe cooling water into single oil cooler only—this feature of G.E.'s Type DP turbine saves time and extra piping costs in turbine installation.

ANOTHER PLUS VALUE OF G-E MECHANICAL-DRIVE TURBINES...

Single Oil Cooler Saves Extra Turbine Piping Costs

You save on installation costs with a G-E mechanical-drive turbine because General Electric pipes the bearing oil back to a single reservoir for cooling, in a single oil cooler. This eliminates the extra costs of running cooling water piping to and between each bearing. This feature alone can save you up to $50.00.

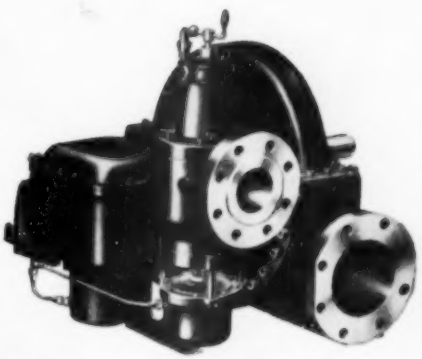
This single oil cooler is just one of the many features on the Type DP turbine which save you money. The chart below indicates other areas of savings.

Remember—the total cost is often more than just the sales price. But G.E.'s standard DP turbines include the extra features that save you extra costs. For more information contact your nearest G-E Apparatus Sales office. Write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." General Electric Company, Schenectady 5, N. Y. 752-64

GENERAL ELECTRIC

INSTALLATION AND MAINTENANCE COST-SAVING FEATURES

THESE EXTRA FEATURES, STANDARD ON ALL G-E TYPE DP TURBINES, CAN . . .	Save You up to
COMBINED TRIP-THROTTLE VALVE Eliminate extra cost of buying and installing valve ahead of the turbine.	$200.00
SINGLE RESERVOIR FOR COOLING LUBE OIL Eliminate extra cost of piping cooling water to and between bearings.	50.00
MAJORITY OF PARTS INTERCHANGEABLE One set of spare parts protects several units—less money tied up in inventory.	100.00
METALLIC-LABYRINTH VALVE STEM BUSHING Eliminate labor costs of replacing soft packings; cut down-time production losses.	50.00
SHAFT MONEL-SPRAYED AT PACKING FIT Saves frequent cost of purchasing and installing carbon rings; contributes to long shaft and packing life.	20.00
ESTIMATED TOTAL SAVINGS	$420.00



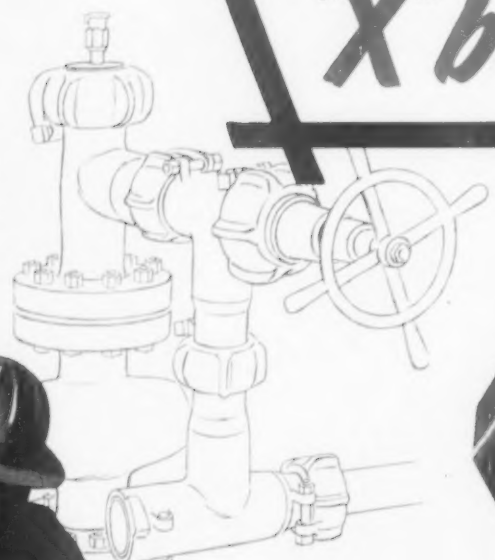
G-E Type DP Mechanical-drive Turbine

COMPARE THE FEATURES
EVALUATE ALL THE COSTS

See why G-E standard Type DP turbines are your most economical buy.

UNIBOLT

Flow-rated "X" beans



Christmas tree equipped with UNIBOLT Flow Manifold, consisting of UNIBOLT Tee, Wing Valve and Positive Choke Body.

YOUR INSURANCE AGAINST HARMFUL OVER-PRODUCING

UNIBOLT Flow Rated X-Beans, provide control of the flow of fluid or gas with a degree of accuracy never before attained. They are drilled in increments of 5 percent and 10 percent of well flow, rather than in increments of 1/64-inch, and are individually flow-rated to assure accuracy.

If, for example, a well produces 10 bbls. through a conventional 5/64-inch choke, to increase the choke to the next largest fractionally drilled size, 6/64-inch, would increase the production to approximately 15 bbls. On the other hand, a well that produces 10 bbls. through a size X-23 UNIBOLT X-Bean would produce only 11 bbls. through the next largest size X-Bean, X-24; 12 bbls. through an X-25, and so on.

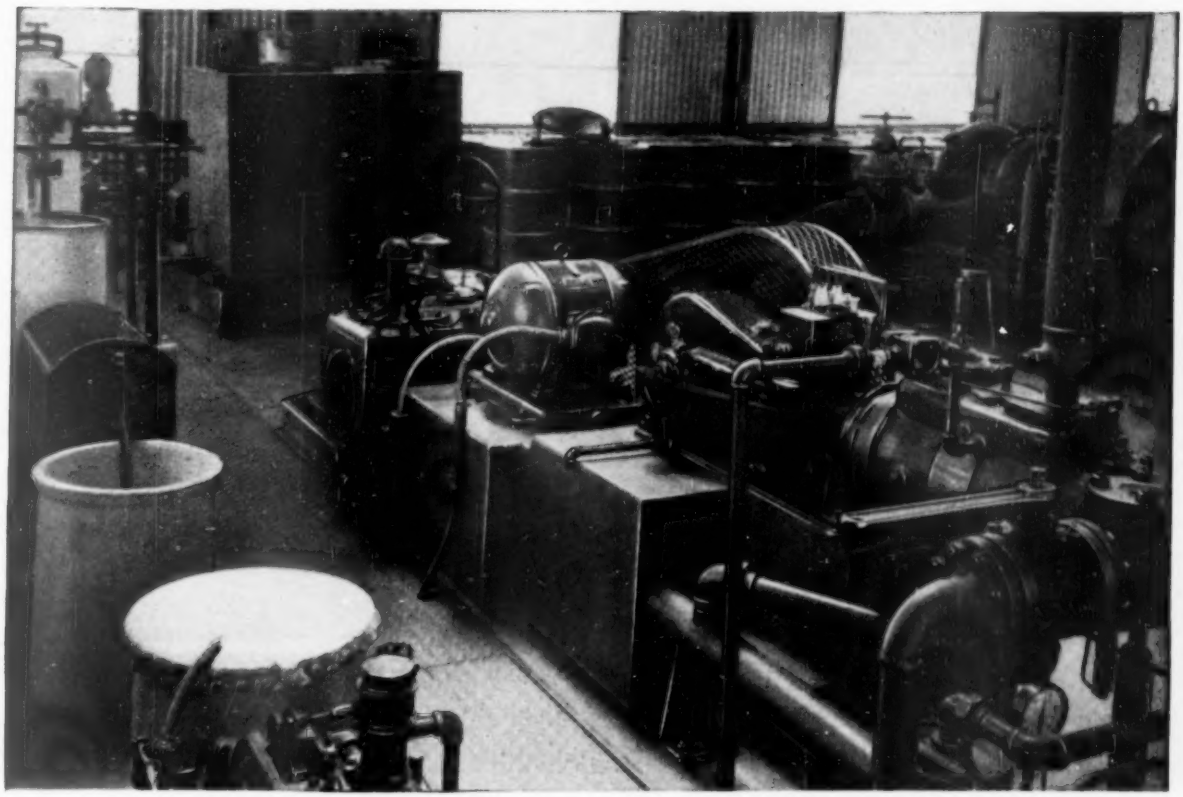
This accurate control of production is a safeguard against the harmful effect of periodically pulling a well too hard in order to make its allowable.

GAS PRODUCERS are benefiting from the use of "X" Beans because the wells can be set with a positive choke for any desired rate of production.

THORNHILL UNIBOLT CRAVER CO.

P. O. BOX 1184 • HOUSTON, TEXAS

Field tests prove **ARQUAD T-2C** cuts costs of secondary oil recovery and gives corrosion protection for your system!



Right here in the field, Armour's new Arquad T-2C has been tried, tested and *proved* by large petroleum producers. The results – over 95% corrosion protection reported in every case (in some cases, *99.5%*) and complete control of sulphate reducers! Arquad T-2C also means less plugging of sands, less down-time for filter cleaning. And Arquad T-2C is an extremely *economical* corrosion inhibitor and bactericide – only 6 ppm does the job!

For free samples of Arquad T-2C and further information on all of Armour's Arquads (quaternary ammonium chlorides), send the coupon today! Technical Bulletin E-6, "Chemical Treatment of Oil Wells", and Technical Bulletin G-3, "Combat Corrosion", are also available. And remember that our research and development laboratory is equipped and ready to help you with your problems.

ARMOUR CHEMICAL DIVISION

© Armour and Company 1355 W. 31st St., Chicago 9, Ill.

Mail this coupon with your letterhead

Armour Chemical Division
1355 W. 31st Street, Chicago 9, Illinois

Please send me:

☐ Arquad T-2C sample ☐ Arquads booklet
☐ Tech. Bull. E-6 ☐ Tech. Bull. G-3

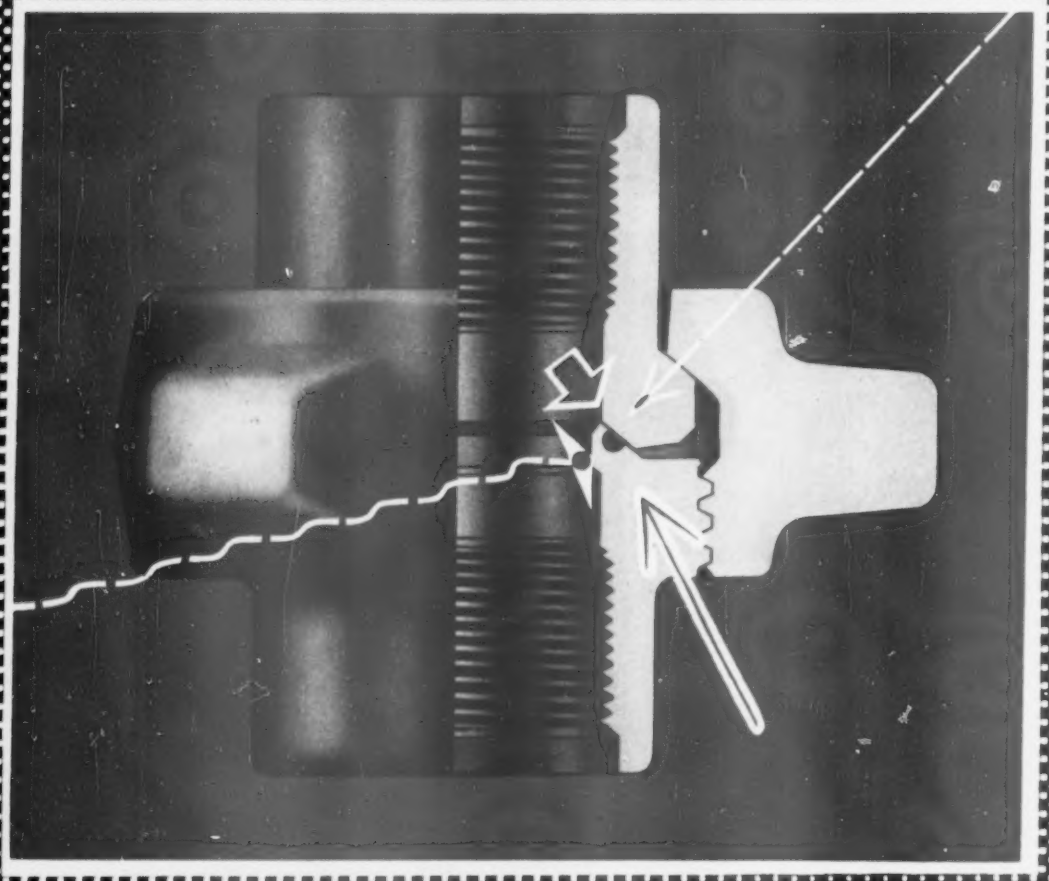
Name _____

Title _____

Firm _____

Address _____

City _____ Zone _____ State _____



did you know O-C-T makes the "O" ring union that may be used to full rated pressure with or without the "O" ring

Here is another reason why O-C-T Type CO unions are tops in performance on your steam and high pressure lines. Impartial tests have praved these unions to be equally efficient at holding high pressures either with or without the "O" ring.

And it will hold high pressures with the nut only hand tight. Because of the ball seat feature, which provides for a misalignment of five degrees or one inch in one foot in any direction from center line, pipe need not be forced into perfect alignment in order to tighten the nut — as must be done with conventional wing unions.

Make sure of better connections on your lines. Ask your supply store about O-C-T Type CO Acme Ball Seat Misaligning Unions. Available through more than 700 supply store locations.

OIL CENTER TOOL COMPANY · HOUSTON, TEXAS

AUTOCAR TRUCKS ARE GOOD FOR YEARS AND YEARS

By replacing an inexpensive bushing, this Autocar owner prolongs indefinitely the life of a much more expensive spring bracket assembly.

An average of 128 renewable bushings are used throughout the Autocar chassis.

Their use permits Autocar to confine wear to inexpensive, easily replaced bushings instead of larger, more costly parts.

Bushings permit the use of different materials to meet different conditions. Connecting rods, brackets, levers, etc., employ bushings of soft metal to prevent scoring more expensive mating parts. Where limited motion or shock resistance is a primary consideration, invariably bushings of hardened steels are specified.

No other truck at any price can show as complete an application of bushings as Autocar.

They are one of the hidden values that permit Autocars to deliver top performance year after year and at minimum maintenance cost.

For more information on Autocars fill in and mail this coupon.

Autocar Division of The White Motor Company
Ardmore, Pa.

Please send me full information concerning Autocar's quality features.

Name _____

Firm Name _____

Address _____

Type of operation _____

No. of trucks in fleet _____

190

AUTOCAR TRUCKS

Autocar Division of The White Motor Company • Ardmore, Pa.

Export: Drexel Building, Philadelphia 6, Pa., U.S.A.

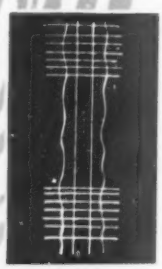
Autocar Trucks are sold and serviced throughout the world

STILL THE ONLY
SERVICE WHICH GIVES YOU

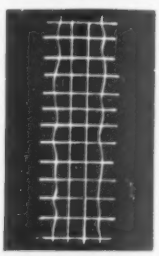
SEMI-SELECTIVE

Shaped Charge Perforating

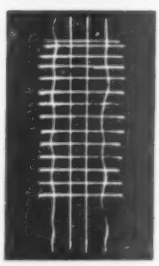
KONESHOT



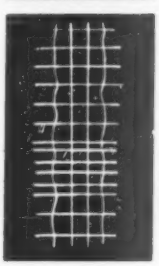
24 Shots in each of two separate 69" sections.



48 Shots in one 141" section.



48 Shots in one 69" section.



48 Shots with double shot density in a chosen section.

Lane-Wells' famous F-2 Semi-Selective Koneshot Gun is made to order for the many jobs which call for the deep penetration of Koneshot, but also need something more than the fixed pattern of regular shaped-charge perforating. Consisting of two 24-shot guns coupled in tandem, the F-2 Gun gives you — *on one run* — any of the options shown at the right. Available in 5 sizes, from 3⅛" o.d. to 5" o.d.

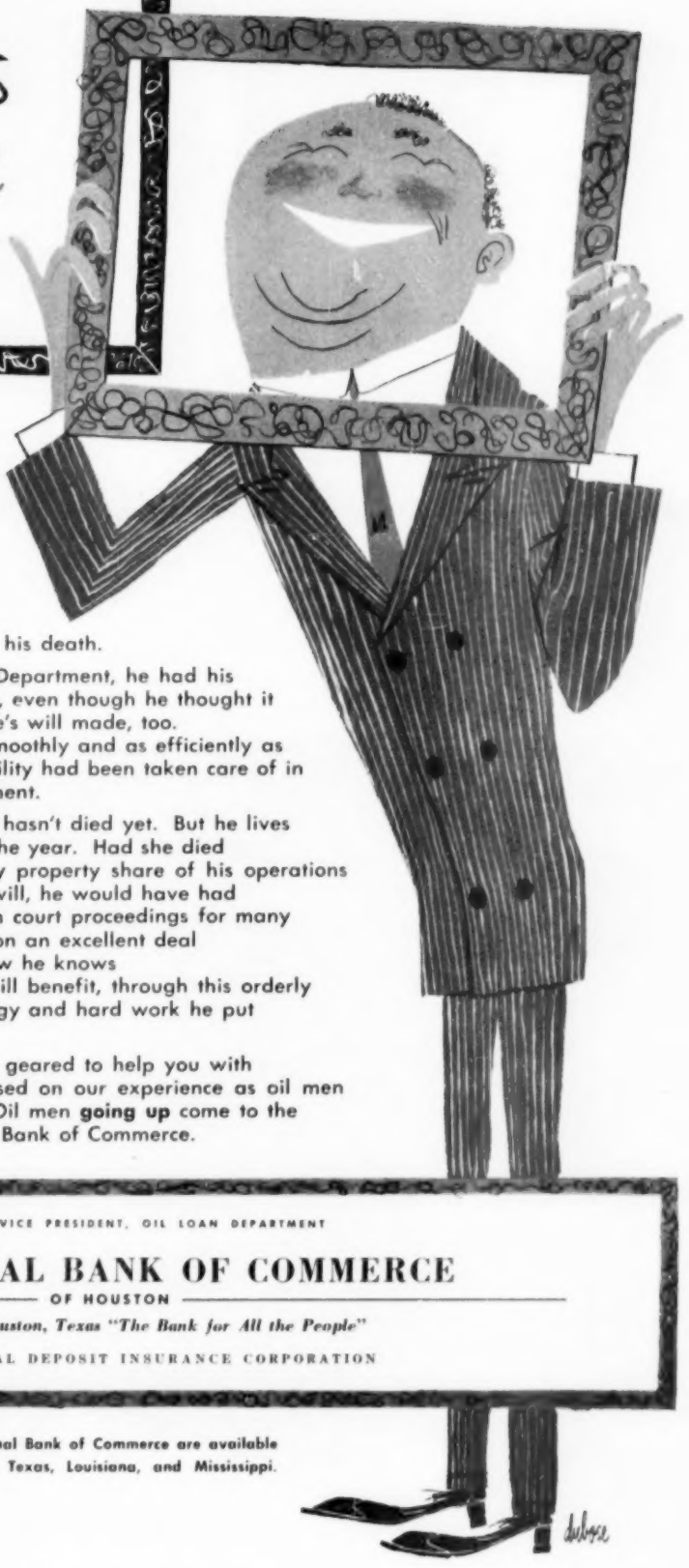
Tomorrow's Tools - Today!®

AK-706

General Offices, Export Office, Plant • 5610 So. Soto St., Los Angeles 58

LOS ANGELES • HOUSTON • OKLAHOMA CITY • LANE-WELLS CANADIAN CO. IN CANADA • PETRO-TECH SERVICE CO. IN VENEZUELA

Mr. "M" was the picture of health



Mr. M. was in the best of health, and when we first suggested that he take certain steps in case of death he thought it was a lot of needless trouble. We showed him how our Trust Department could arrange his affairs in an orderly way, and allow his operation to continue after his death.

Following the advice of our Trust Department, he had his lawyer draw up a will for him. And, even though he thought it was a waste of time, he had his wife's will made, too. His finances were set up to run as smoothly and as efficiently as his oil operation. Every future possibility had been taken care of in the plans made by the Trust Department.

Now this story has a twist. Mr. M hasn't died yet. But he lives in Texas, and his wife died early in the year. Had she died without a will, and if her community property share of his operations had not been taken care of by such will, he would have had a sizable part of his estate tied up in court proceedings for many months. He would have missed out on an excellent deal which he was able to make. And now he knows that when he does die his children will benefit, through this orderly financial arrangement, from the energy and hard work he put into building his holdings.

The National Bank of Commerce is geared to help you with your problems. Impartial advice, based on our experience as oil men and money men will help you, too. Oil men **going up** come to the Oil Loan Department of The National Bank of Commerce.

E. O. BUCK, VICE PRESIDENT, OIL LOAN DEPARTMENT

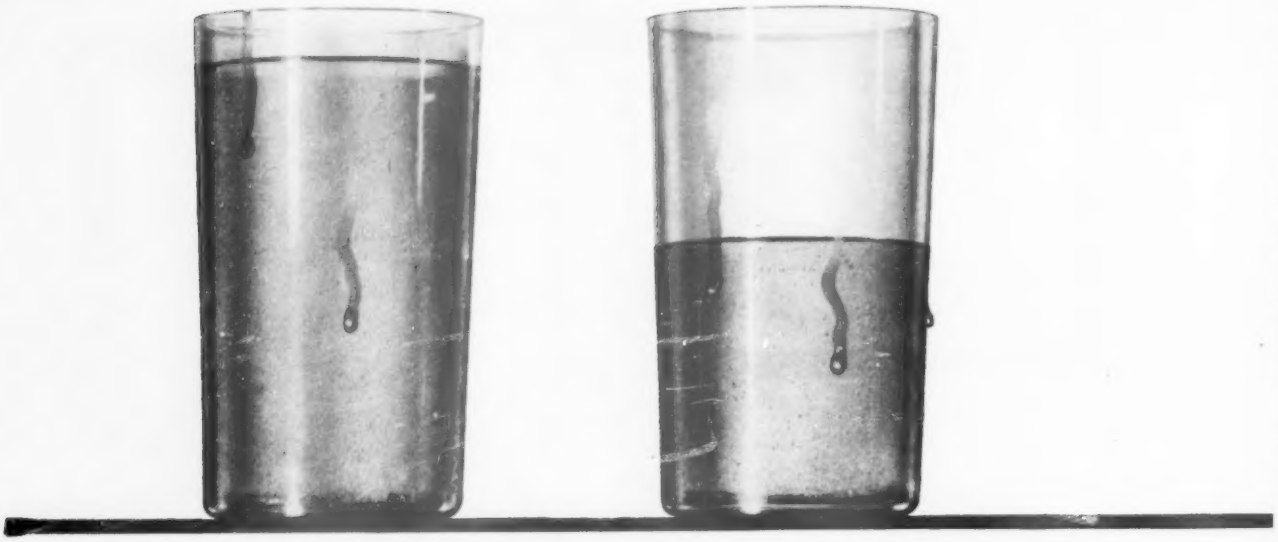
THE NATIONAL BANK OF COMMERCE

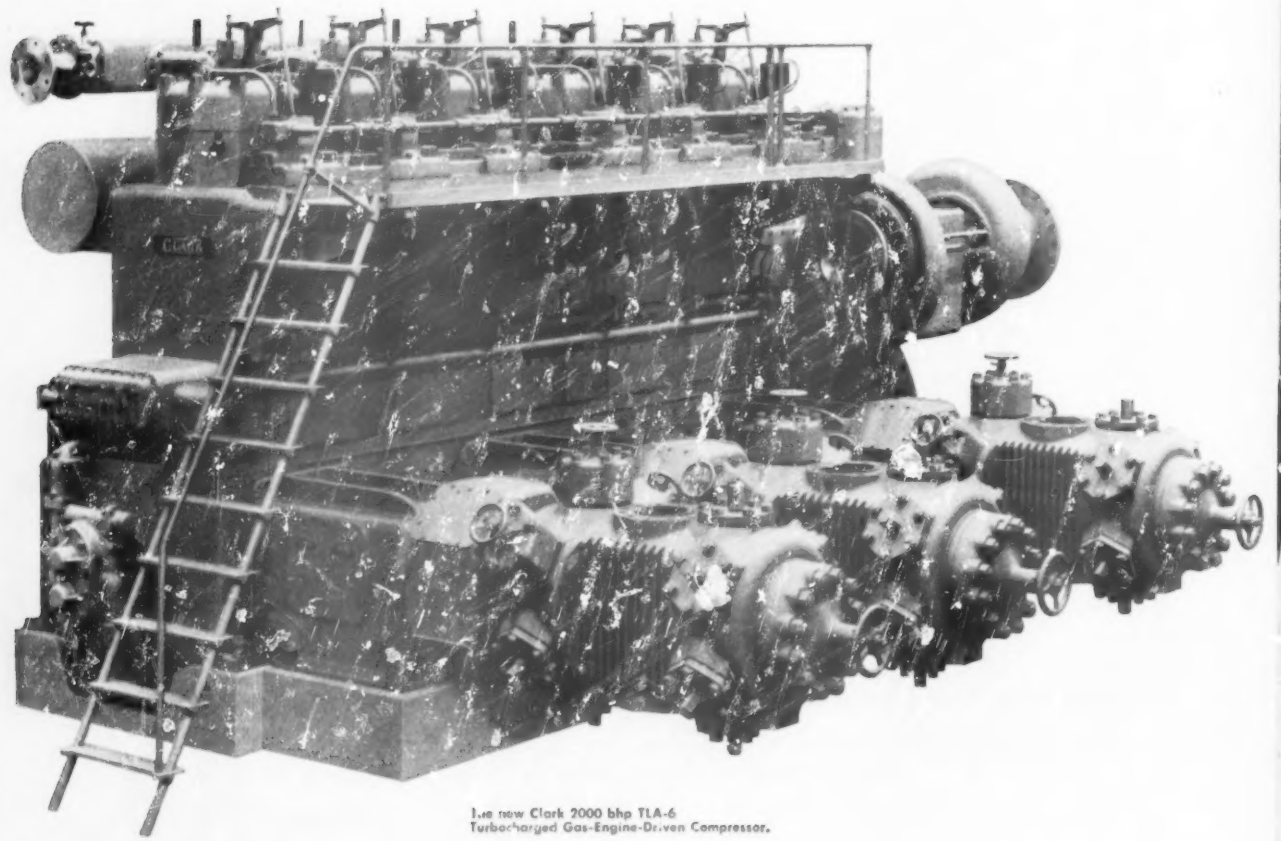
OF HOUSTON

Gulf Building, Houston, Texas "The Bank for All the People"

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Facilities of the Oil Loan Department of The National Bank of Commerce are available in Wyoming, Colorado, Nebraska, New Mexico, Texas, Louisiana, and Mississippi.





Use new Clark 2000 bhp TLA-6
Turbocharged Gas-Engine-Driven Compressor.

40% less water!

for cooling Clark Turbocharged Compressors

40% reduction in cooling water rates over comparable non-turbocharged compressors — that's what you save with Clark 2-Cycle Turbocharged Compressors. It's not hard to realize, of course, what big savings this will mean in your installation and operating costs.

How is this tremendous reduction in cooling water requirements made possible? Because these new Clark Compressors operate at higher thermal efficiency, much of the heat which was formerly rejected to the cooling water is now converted to useful work. Translate this into direct benefits, such as smaller cooling towers, fewer wells, smaller pipes and pumps, less water treating materials — and you can easily figure your own savings in installation and operating costs.

Add these savings to those that come from a 12½% reduction in fuel consumption, a 25% to 30% reduction in foundation and building costs — plus many other highly important features — and you'll quickly conclude that this is the most economical compressor to install and to operate.

Simple and dependable, like all Clark 2-Cycle "Angle" Compressors, the Turbocharged Models TRA and TLA are available in sizes ranging from 825 to 3300 bhp.

For complete details, call your nearest Clark representative or write for Bulletin 130.

CLARK BROS. CO. • OLEAN, N. Y.

DIVISION OF DRESSER OPERATIONS, INC.

SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

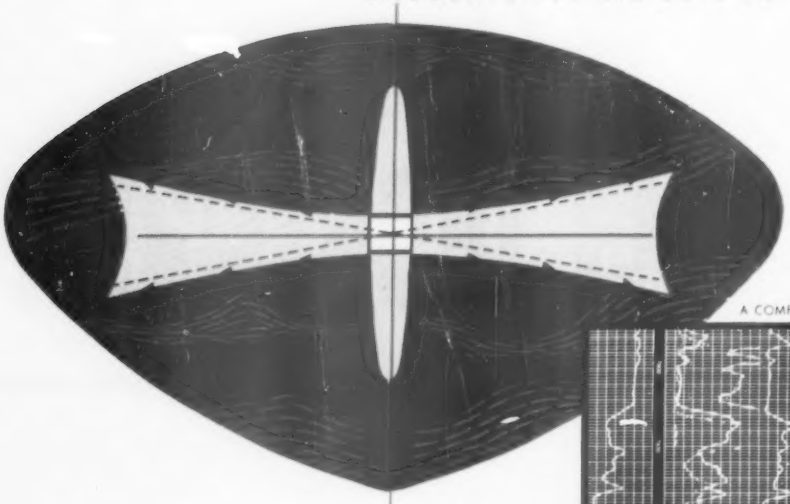
CLARK *Compressors*

Clark sets the pace in compressor progress

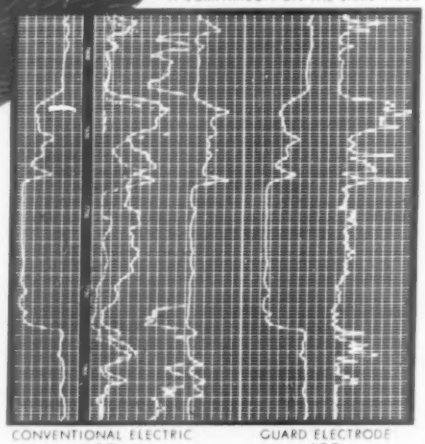
GUARD ELECTRODE

BEST FOR LOGGING ERRATIC LITHOLOGY...

ACCOUNTS FOR BIG CUTS IN WELL COSTS



A COMPARISON ON THE SAME WELL



CONVENTIONAL ELECTRIC LOG

GUARD ELECTRODE LOG

Fully developed in recent years, the Guard Electrode system has saved much time and money for operators by its remarkable ability to better evaluate erratic formations.

Eliminating the distortions that plague conventional electric logging, Halliburton's Guard Log improves accuracy of interpretations and increases efficiency of coring and drill stem testing.

Guard Log offers several advantages. Because its measuring current assumes the shape of a flat, thin disk that runs at right angles to the electrode, all spacing effects and detrimental anomalies are absent. This allows Guard Log to represent actual lithologic conditions more closely.

It improves fluid interpretation because its focused current permits accurate resistivity measurements . . . even when the formation is interspersed with lignite streaks above or below possible pay zone sands . . . allowing more precise predictions as to fluid content.

Rely on Halliburton's Guard Log to gain most pertinent data on erratic lithology . . . and to cut your well costs. Phone your local or district Halliburton office. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON

ELECTRICAL WELL SERVICES

YEARS AHEAD IN PRODUCTION IMPROVEMENT TECHNIQUES!

They Say—

Employe Relations Advice

"The main thing is to really want to let your people know what your are doing, and what you are thinking, and be interested in what they are thinking. Then tell them a little too much rather than much too little and remember to listen.

"Let's solicit union and employe participation whenever we properly can—up to the point of too much dilution of management's obligation to manage.

"The important thing is that we are interested in finding out what employes want rather than making up our own minds what they want—or what we think they should want."

Dr. W. J. McGill, general manager of industrial and public relations, Standard Oil Co. (Ind.), Chicago, before a regional personnel clinic sponsored by the Burlington, Iowa, Chamber of Commerce and the National Association of Manufacturers.

Excess Refinery Capacity Normal

". . . Changes have taken place since the end of World War II which give some people concern. One of these is that the refinery capacity of the domestic industry is considerably in excess of current refinery runs to stills.

"Historically, the industry ran its refineries at 75 per cent to 80 per cent of capacity. We believe refinery runs for 1954 will be around 87 per cent or 88 per cent average for the year. This rate of runs is altogether normal and although there may be some 13 per cent unused capacity, such situation is entirely in keeping with history, simply meaning that the industry is a little ahead of the actual current demand.

"Under ordinary circumstances, this reserve capacity will not be needed for a year or two, but it provides a cushion for the unexpected. The industry cannot afford to be without a fairly substantial peacetime cushion of this kind."

Clark S. Teitsworth, vice president Socony-Vacuum Oil Co., Inc., before the Oil Analysts Luncheon Group of New York.

Pipelines Should Look for Gas

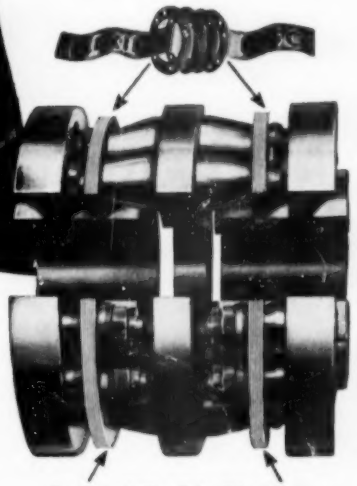
"The producer will not engage in (natural gas) exploration unless he receives a field price that justifies the risk. Consequently, the consumer must pay such price in the rate if he is to get the gas. This being true, it certainly follows that his interest will be best served by encouraging the pipeline companies to explore for and produce gas, rather than to leave such exploration and production to the independent producer who has no direct connection with or obligation to the consumer.

"The pipelines have or can acquire the technical skill to engage in exploration . . . Through their engineering departments they have knowledge of production technique. Through their geological departments . . . they have acquired a great mass of geological data, the very basis upon which exploration is carried out. . . .

The pipeline companies have billions of dollars of capital invested in pipelines which must be of no value at the end of 20 to 25 years unless additional reserves are discovered available to their systems.

"And yet under the Federal Power Commission rule they are placed at a distinct disadvantage in exploring for gas in competition with the very producers from whom they must buy their supply or curtail or discontinue their service to their consumers. This would certainly appear to be against the in-

Specify THOMAS ALL METAL FLEXIBLE COUPLINGS for Power Transmission to avoid Costly Shut-Downs



REFINERS! PIPE LINE MEN!
DRILLING ENGINEERS!
LABORATORY TECHNICIANS!

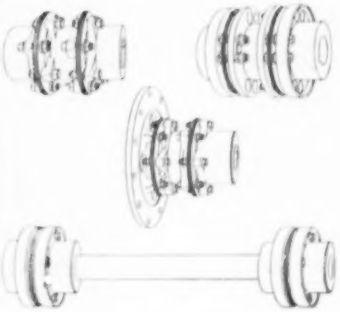
You can use Thomas Couplings to your advantage on Pumps, Compressors, Cooling Towers, Rigs or any other tough job where continuous operation and dependability are required.

Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.

Thomas Couplings are made for a wide range of speeds, horsepower and shaft sizes.

DISTINCTIVE ADVANTAGES

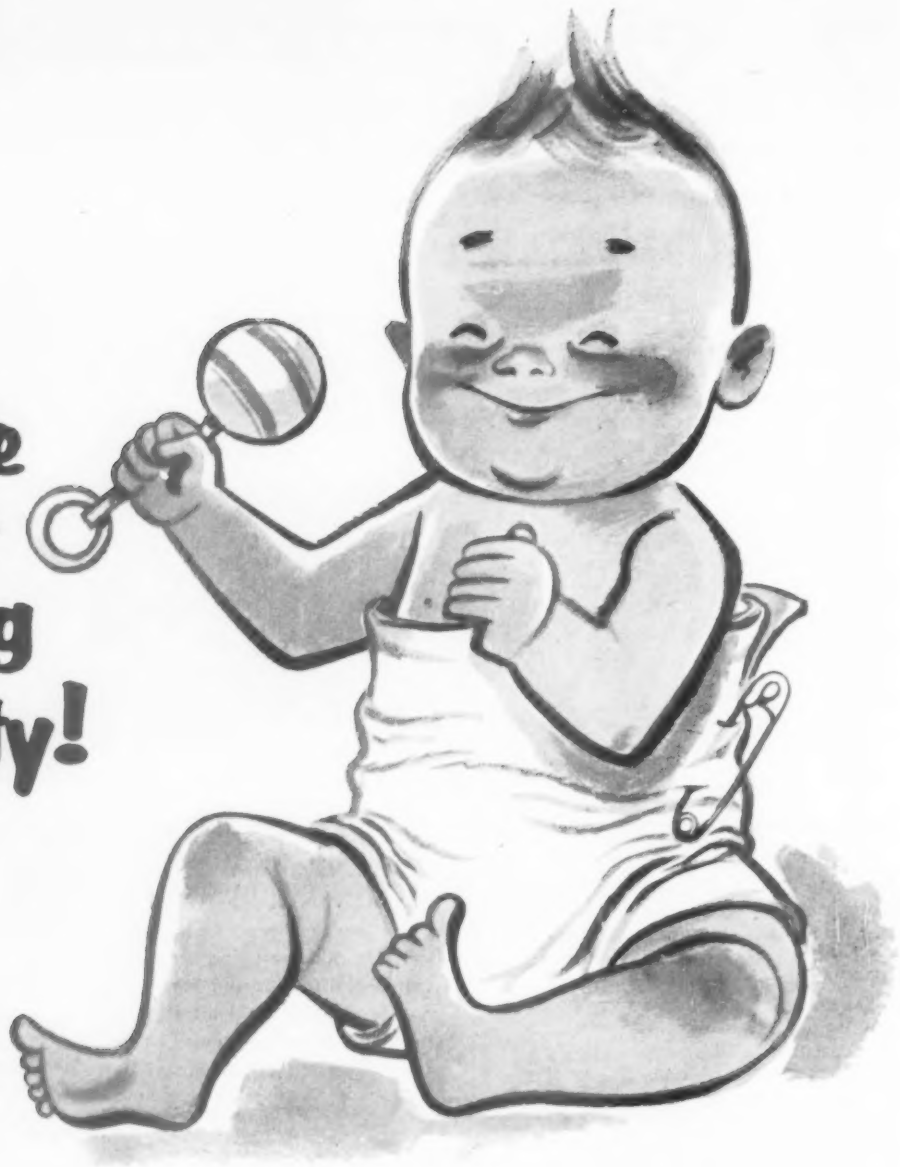
FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



Write for our new Engineering Catalog No. 51A

THOMAS FLEXIBLE COUPLING COMPANY
Largest Exclusive Coupling Manufacturer in the World
WARREN, PENNSYLVANIA, U.S.A.

Double Your Drying Capacity!



S/V Sovabeads Increase Dehydrator Efficiency Almost 100%

Yes, it's true—S/V *Sovabeads* will almost *double* the efficiency of your dehydrator units—maintain this efficiency at temperatures as high as 120° F.! And look at these other advantages:

S/V Sovabeads provide a longer desiccant bed life. They eliminate caking . . . reduce channeling, dusting and pressure drops. Reactivation is quick, easy and economical.

* * *

Why wait to improve *your* dehydration operations? Call your Socony-Vacuum Representative today for full information about S/V Sovabeads.

SOCONY-VACUUM
. . . process products

Process Products

SOCONY-VACUUM OIL CO., INC., 26 Broadway, New York 4, N. Y., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP.

terest of the consumer, and in the end result in a higher rate for less service."

Paul Kayser, president, El Paso Natural Gas Co., addressing the Permian Basin Section of the Natural Gasoline Association of America, Odessa, Tex.

Development Opportunities Promising

"I believe it is no exaggeration to say that never before in the history of oil have the opportunities for future development been more obvious and more promising than they are today.

"We have long thought of petroleum as a substitute for wood and coal in the generation of heat and as a substitute for turpentine in the manufacture of spirits and paint. Now we begin to think of it as a substitute for steel in the manufacture of automobile bodies, even as a substitute for straw in the manufacture of summer hats.

"If we work hard at our jobs and make every effort to reduce our costs and increase our efficiency, the future prosperity of our industry seems assured."

John G. Pew, vice president, Sun Oil Co., in an address before the Southwestern District meeting of the American Petroleum Institute Division of Production.

Price of Progress High

"As I have tried to emphasize, however, the price of progress has not been cheap. In meeting expanded commitments for commercial gas, and particularly in keeping abreast of our enormously increased heating gas demand, Peoples has had to throw open its pursestrings to the point where it often hurt—and, I might add, is still hurting."

John J. Jacob, Jr., president, Peoples Natural Gas Co., before members of the Pittsburgh, Pa., Real Estate Board.

CALENDAR OF EVENTS

APRIL

- **6** New Jersey Section of the Instrument Society of America, sixth annual symposium, Essex House Hotel, Newark, N. J.
- **6-8** Petroleum Industry Electric Association and Petroleum Electric Supply Association, joint annual meeting and exhibit, Adolphus and Baker Hotels, Dallas.
- **7** Packaging Institute, annual spring luncheon, Hotel Dennis, Atlantic City, N. J.
- **8- 9** American Petroleum Institute, Division of Production, Rocky Mountain district meeting, Townsend Hotel, Casper, Wyo.
- **8- 9** Second annual instrumentation con-

"Here's My Problem"
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First, one of our older buildings has areas which need spot ventilation. Then, in another building, we're going to need large-capacity exhaust to get rid of dust and moisture. Finally, we need additional capacity in an old system where we've just installed some air cleaning equipment. Now, my problem is . . .

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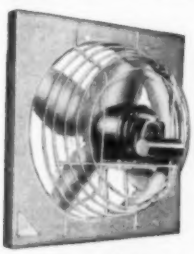

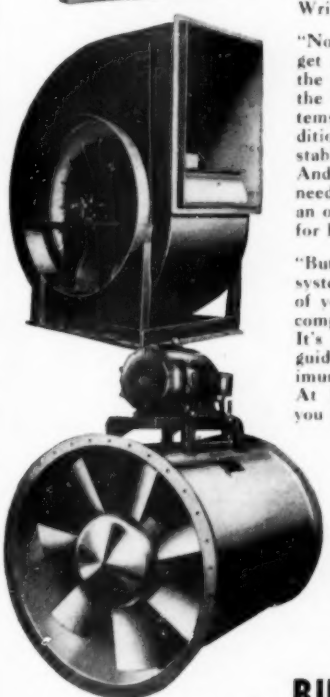

BUFFALO REPRESENTATIVE: "To begin with, no single type of fan is the best solution to *all* problems. The best and cheapest answer to your spot ventilation, for instance, is the new Type "NV" Breezo Fan. An efficient propeller fan with strong rigid, die-formed square panel, the "NV" is simple to install in outside walls wherever you need to exhaust stale air. It can be operated free-air or duct-connected (¼" to ½" s.p.) equally well. The "NV" is made in sizes for 500 to 5500 cfm capacities, and if you need larger capacity, use the new "NV" Heavy-Duty Belt-Air, it's in sizes up to 90,000 cfm. Write for Bulletin 3865 & F-3790.

"Now, for your large-capacity exhaust system, you'll get greatest long-run satisfaction and economy with the new Type 'BL' Limit-Load centrifugal fan. It's the type recommended most frequently for large systems—straight ventilation, air washer and air conditioning supply. You can't overload it, and it gives stable performance from shut-off to free air delivery. And you can pick exactly the rated capacity you need, from 1,000 to 500,000 cfm, with no waste in an oversize fan or over-specified driving power. Write for Bulletin F-100.

"But where you need to step up the capacity of a system, mount an axial flow fan in a straight portion of your ductwork. The 'Buffalo' Axial Flow is light, compact and takes little more space than your duct. It's extremely efficient in straight runs, and has guide vanes to keep turbulence and noise at a minimum. So you see, there is no *one* fan for all jobs. At Buffalo, we make all types and sizes, so that you can pick one that's practically tailored to your particular need. We've been building fans for 77 years, too, which means that you can be sure of any 'Buffalo' fans you pick." Write for Bulletin 3533-C.

SUGGESTION: Most important of all, remember that Buffalo Engineering Sales Representatives are all technical graduates, factory trained for a number of years; they know fans and their application. Located in all principal cities, they are ready to assist you, too, in fan selection. Why not call on yours today?

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ference, Louisiana Polytechnic Institute, Ruston, La.

9-10 American Society of Civil Engineers, first pipeline conference, Hotel Scharbauer, Midland, Tex.

12-15 American Association of Petroleum Geologists, Society of Exploration Geophysicists, and Society of Economic Paleontologists and Mineralogists, joint annual meeting, Kiel Auditorium, St. Louis.

13-15 Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, Okla.

14-16 National Petroleum Association, fifty-first semiannual meeting, Cleveland Hotel, Cleveland.

15-16 Sixth National Personnel Conference of the Gas Industry, American Gas Association and Southern Gas Association, Edgewater Beach Hotel, Chicago.

17 Fourth John Zink Process Heating Seminar, John Zink Burner Co. plant, 4401 S. Peoria, Tulsa.

19-21 National Purchasing and Stores Conference, sponsored by the American Gas Association, Atlanta, Ga.

20-23 Distribution, Motor Vehicles and Corrosion Conference, Operating Section, American Gas Association, Mount Royal Hotel, Montreal.

21-23 1954 Southern Industrial Wastes Conference, Manufacturing Chemists Association Southern Association of Science and Industry, and the Texas Chemical Council, Houston.

21-23 Natural Gasoline Association of America, thirty-third annual convention, Baker Hotel, Dallas.

22 Illinois Oil and Gas Association, annual membership meeting, Hotel Emmerson, Mount Vernon, Ill.

22-23 West Texas short course on oil-lifting methods, Texas Technological College, Lubbock.

26-28 Southern Gas Association, annual convention, Houston.

27 Distillation in Practice, second of an Experience in Industry series, Philadelphia-Wilmington section of the American Institute of Chemical Engineers and University of Pennsylvania, University Museum, Philadelphia.

MAY

2- 4 Independent Petroleum Association of America, midyear meeting, Cosmopolitan Hotel, Denver.

3- 5 American Geophysical Union, thirty-fifth annual meeting, National Academy of Sciences, Washington, D. C.

3- 5 Air Pollution Control Association, annual meeting, Patten Hotel, Chattanooga, Tenn.

4-7 American Welding Society, national spring meeting, Hotel Statler, Buffalo, N. Y.

6- 7 American Petroleum Institute, Division of Production, Pacific Coast district meeting, Statler Hotel, Los Angeles.

9-12 Liquefied Petroleum Gas Association, annual convention and trade show, Conrad Hilton Hotel, Chicago.

10-12 Ninth annual Purdue Industrial Waste conference, Purdue Memorial Union, Lafayette, Ind.

10-12 American Petroleum Institute, Division of Transportation, Products Pipe Line Conference, Warwick Hotel, Philadelphia.

10-13 American Petroleum Institute, Division of Refining, midyear meeting, Rice Hotel, Houston.

12-13 Pacific Coast Gas Association, gas supply and transmission conference, Mark Hopkins Hotel, San Francisco.

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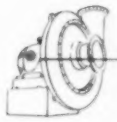

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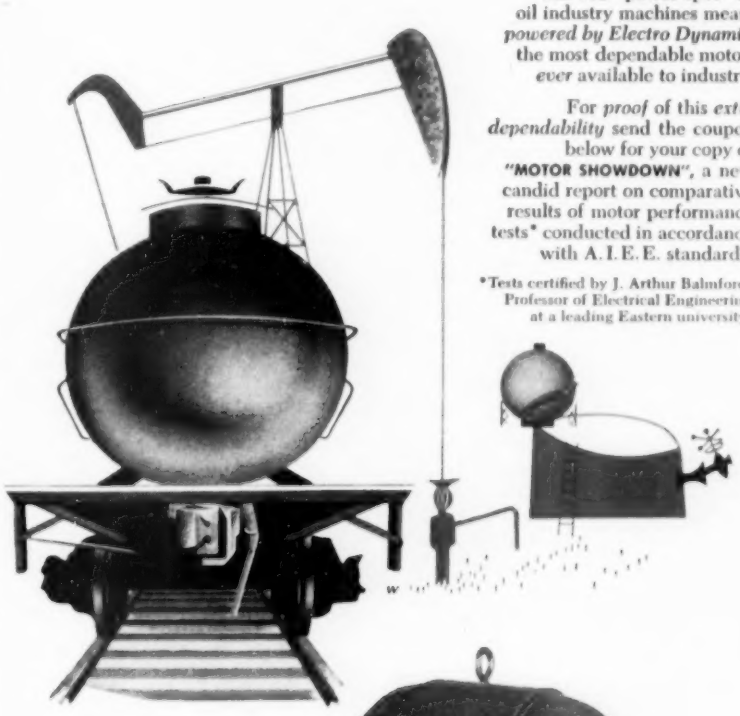

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14-15 Interstate Oil Compact Commission, General Oglethorpe Hotel, Savannah, Ga.

16-19 American Institute of Chemical Engineers, Springfield, Mass.

17-19 American Petroleum Institute, Division of Marketing, midyear meeting, Cosmopolitan Hotel, Denver.

20-21 Kentucky Oil and Gas Association annual meeting, Lafayette Hotel, Lexington, Ky.

24-26 American Gas Association, production and chemical conference, William Penn Hotel, Pittsburgh.

27-28 Natural Gas and Petroleum Association of Canada, Prince Albert Hotel, Windsor, Ont., Canada.

31-June 5 American Petroleum Institute, Division of Production, midyear committee conference, St. Francis Hotel, San Francisco.

JUNE

2-4 Southern Gas Association, short course in gas technology, Texas College of Arts and Industries, Kingsville, Tex.

2-4 Ninth annual short course in gas technology, Texas A.&I. College, Kingsville, Tex.

3- 4 Pennsylvania Grade Crude Oil Association, thirty-first annual meeting, Hotel William Penn, Pittsburgh.

6-11 Society of Automotive Engineers, summer meeting, Ambassador and Ritz-Carlton Hotels, Atlantic City, N. J.

13-18 American Society for Testing Materials, annual meeting and exhibit, Sherman and Morrison Hotels, Chicago.

17-19 American Petroleum Institute, Division of Production, eastern district meeting, Greenbrier Hotel, White Sulphur Springs, W. Va.

20-24 Canadian Gas Association, Banff Springs Hotel, Banff, Alta., Canada.

JUNE 20-
JULY 4 Seventh annual Conferences on Personnel Administration and Managerial Development, Industrial Relations Section of the California Institute of Technology, California Institute of Technology, Pasadena, Calif.

24-25 Western Petroleum Refiners Association, regional meeting, Leonard refineries auditorium, Alma, Mich.

25-26 Southern Gas Association, transmission management conference, Hotel Adolphus, Dallas.

27

July 1 Petroleum Equipment Suppliers Association, nineteenth annual meeting, Manoir Richelieu, Murray Bay, Que., Canada.

JULY

23 Southern Gas Association, communications conference, Rice Hotel, Houston.

24 Southern Gas Association, dispatchers' conference, Rice Hotel, Houston.

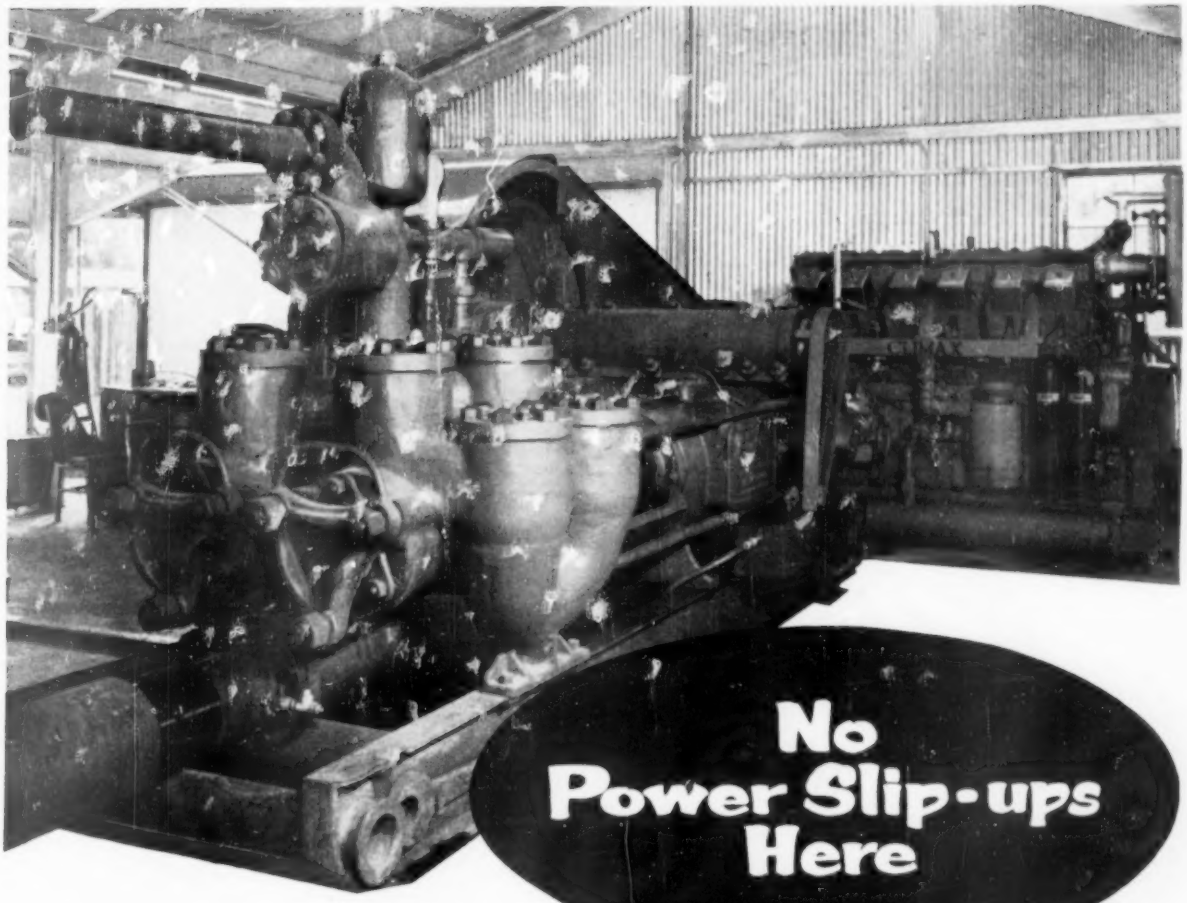
AUGUST

16-18 Society of Automotive Engineers, West Coast annual meeting, Statler Hotel, Los Angeles.

20 Southern Gas Association, natural-gas processing conference, Herring Hotel, Amarillo, Tex.

21 Southern Gas Association, pipe-line operations conference, Herring Hotel, Amarillo, Tex.

26-28 (tentative) Intermountain Association of Petroleum Geologists, fifth annual field conference, beginning at Price, Utah.



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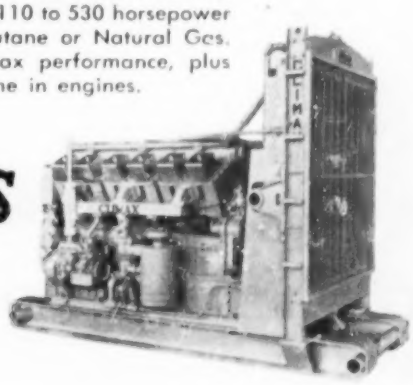

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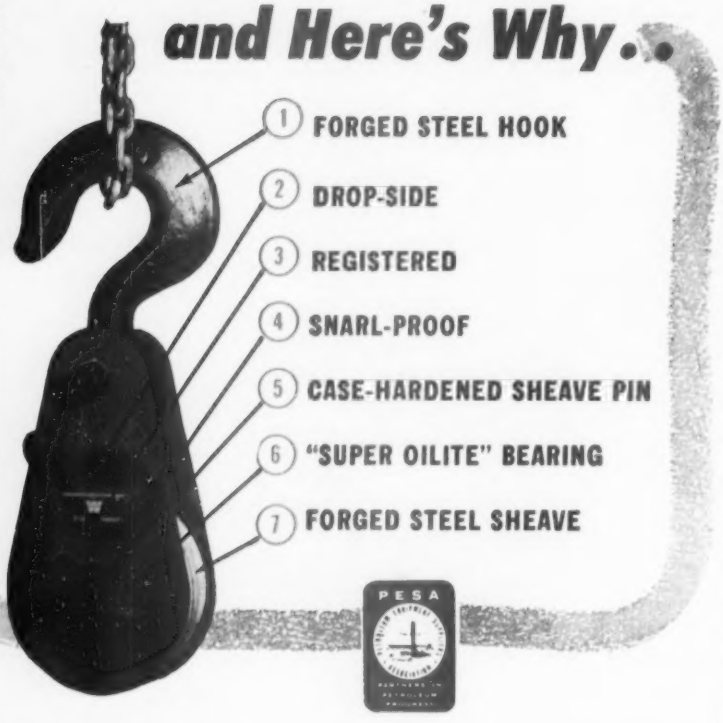

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SEPTEMBER

7-9 Association of Desk and Derrick Clubs of North America, annual convention, Banff Springs Hotel, Banff, Alta.

8-10 Pacific Coast Gas Association, sixty-first annual meeting, Vancouver Hotel, Vancouver, B. C.

9-11 Interstate Oil Compact Commission, Omaha, Neb.

12-16 American Institute of Chemical Engineers, Colorado Hotel, Glenwood Springs, Colo.

15-17 National Petroleum Association, fifty-second annual meeting, Traymore Hotel, Atlantic City, N. J.

16-17 Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, annual meeting, Roosevelt Hotel, New Orleans.

23-24 Western Petroleum Refiners Association, regional meeting, Henning Hotel, Casper, Wyo.

25 Southern Gas Association, compressor-station conference, Captain Shreve Hotel, Shreveport, La.

27-29 Electrical Conference for Petroleum Industry, American Institute of Electrical Engineers, Mayo Hotel, Tulsa.

OCTOBER

2 Southern Gas Association, right-of-way conference, Peabody Hotel, Memphis, Tenn.

4-6 Texas Mid-Continent Oil and Gas Association, annual meeting, Plaza Hotel, San Antonio, Tex.

4-6 Petroleum Electric Power Association, twenty-sixth anniversary meeting, Jung Hotel, New Orleans.

7-8 California Natural Gasoline Association, twenty-ninth annual fall meeting, Ambassador Hotel, Los Angeles.

7-8 American Institute of Mining and Mettallurgical Engineers, Pacific Petroleum chapter, fall meeting, Biltmore Hotel, Los Angeles.

9 Southern Gas Association, field production of natural gas roundtable, Rice Hotel, Houston.

11-13 American Gas Association, annual convention, Atlantic City, N. J.

11-13 American Association of Oilwell Drilling Contractors, annual meeting, Biltmore Hotel, Los Angeles.

12-15 Eighth National Chemical Exposition, Chicago Coliseum, Chicago.

14-17 Permian Basin Oil Show, Odessa, Tex.

16 Southern Gas Association, transmission management conference, Rice Hotel, Houston.

17-20 American Institute of Mining and Metallurgical Engineers, petroleum division, fall meeting, Plaza Hotel, San Antonio.

24-26 Independent Petroleum Association of America, annual membership meeting, Mayo Hotel, Tulsa.

26-27 Society of Automotive Engineers, national diesel engine meeting, Statler Hotel, Cleveland.

NOVEMBER

4-5 Society of Automotive Engineers, national fuels and lubricants meeting, Mayo Hotel, Tulsa.

8-11 American Petroleum Institute, thirty-fourth annual meeting, Conrad Hilton Hotel and Palmer House, Chicago.

28-Dec. 3 American Society of Mechanical Engineers, Statler Hotel, New York.

DECEMBER

2-4 Interstate Oil Compact Commission, winter meeting, Drake Hotel, Chicago.

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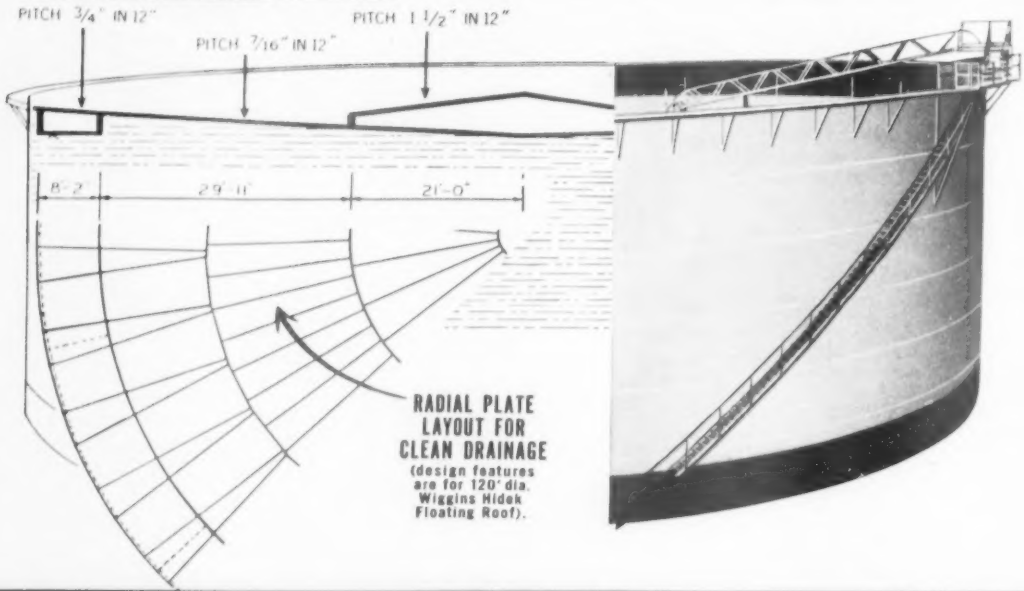
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THE OIL AND GAS

JOURNAL

TULSA, OKLAHOMA

Published every Monday by The Petroleum Publishing Co., 211 S. Cheyenne, Tulsa, Oklahoma. Phone 3-6291. Founded in 1902. Name changed to The Oil and Gas Journal in 1910 by Patrick C. Boyle.

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JOURNALLY Speaking

Good-by, Mr. Hyphen

WEEKS and weeks ago we received a highly embarrassing letter from a very observing reader. We haven't been able to answer it until now because it took so long to reach a decision. Here's the letter:

"The Oil and Gas Journal, along with most pipeline companies, spells pipeline two words, pipe line. We have a spanking new, big, unabridged Webster's International in our office and it lists pipeline as one word. Not even a hint of pipe line or pipe-line; it isn't even listed as second choice, although there are a lot of two-word pipes such as pipe metal, pipe office, pipe organ, pipe key, pipe grip, pipe head, pipe fitting, pipe plant, pipe privet (a kind of lilac), pipe loop (harness making), and pipe major—the latter being the chief player in a bagpipe band, which you can have.

"As for a hyphenated word, there is pipe-joint cement, and that's all. Comes now, as the lawyers say, the case for the single word. There is the noun pipeline, single word, the verb transitive, single word, and the adjective pipeline, single word. There is also pipeline run, pipelike, pipeman, pipeplayer, and even the opposite of pipeline, pipeless. But no pipe line, two words.

"The publishers of this Merriam-Webster volume say it cost $1,300,000 to compile and print. They also say there are 600,000 entries, which would make the cost of each entry $2.16. Thus presumably it cost them $2.16 to find that the correct spelling of pipeline noun is pipeline, and ditto for pipeline adjective and pipeline verb transitive. That's a total of $6.48 to establish pipeline as one word.

"Now I have been brought up to respect Webster's Unabridged. In the past few years I have learned to respect The Oil and Gas Journal. But what I want to know is, how much money did The Oil and Gas Journal spend to spell pipe line as two words? Or what dictionary do you use, or haven't you been? A company has the right to spell its company name any way it pleases, but the bible of the oil industry and the dictionary—which is out of step?"

Well, we have to admit that we have been out of step with the dictionary. We didn't notice it until this reader brought us up short with his $6.48 question. But we have a good alibi.

We have a style manual, a formidable, all-inclusive, 138-page stylebook, which rigidly dictates all spelling, punctuation, word forms, and abbreviations used in the Big Yellow Book. And it instructs us to write pipe line (noun), pipe-line (adjective), pipe lining (verb), and pipe liner (man).

This sacrosanct stylebook, this bible of the oil-man's bible, was written in 1939, and dictionaries of that era confirm that the forms used in our stylebook were preferred back in those days. But English usage is a fluid thing, changing constantly, and the dictionary reflects these changes. In recent years there has been a general tendency to run compound words together, do away with many hyphens, and shorten and simplify typographical style in many respects.

That's what happened to pipe line. It used to be two words as a noun and hyphenated as an adjective. Lately so many people have been running it together that Webster has accepted the change whole hog, as this reader points out so devastatingly.

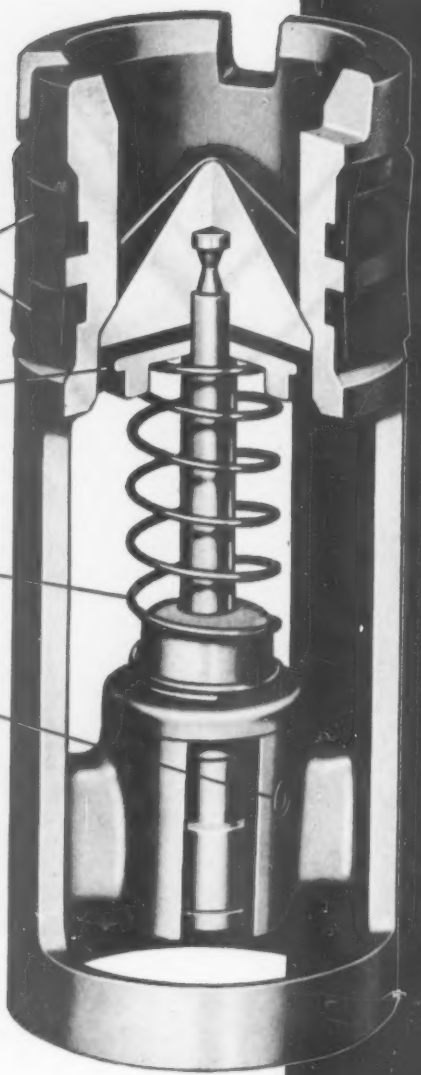
We will now do the same. We hereby bow to progress, break off the shackles of tradition, and get in step with Mr. Webster. Henceforth and forevermore the word will appear in our pages only as pipeline, repeat, PIPELINE. (That is, it will as soon as we can break all our staff of the habit of a lifetime).

And why was this a difficult decision? Brother, you have no idea how important a hyphen is to an editor or printer. It makes as much difference to some of us as a decimal point does to an engineer. It took a lot of soul searching to drop the hyphen out of pipeline. But now it's gone. Good-by, Mr. Hyphen.

—*Henry D. Ralph.*

Now... better than ever...

Baker Drill Pipe Float Valve



SIDE SEALS REVERSED

to prevent distortion of seals by trapped fluid. Valve is easily removed.

MORE EFFECTIVE SEAL

The redesigned seal between the valve and the valve seat seals better—lasts longer—*stays in place* even under high circulating volumes and high pressures.

LESS SPRING TENSION

Reduces the cutting action of circulating fluid on the valve seal and seat.

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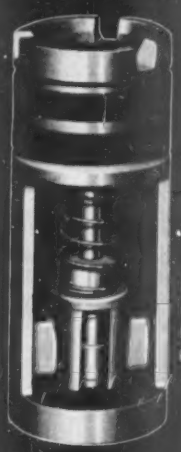
The valve guide is securely held in place by the set screw.

New! BAKER MODEL "F" DRILL PIPE FLOAT VALVE



Baker Model "F" Drill Pipe Float Valve, Product No. 4813

Suggestions of drilling contractor and drilling department personnel have helped in redesigning and improving Baker Drill Pipe Floats so that they are *now better than ever.* They will save *you* time and money, muss and fuss, in every string.

POSITIONED WHERE DESIRED—A majority of operators install the Baker Drill Pipe Float Valve in a recess in the lower end of the drill collar where it is held in position by the pin on the drilling bit. Or the Valve can be positioned in a Drill Pipe Float BODY which serves as a tool joint sub at any point in the string.

EASILY INSTALLED AND SERVICED—The strong, simple Valve is made without threads and is merely dropped into place—or just as easily removed—by hand. No tools or wrenches are required. The inexpensive wearing parts are available at your supply store, and servicing is quickly and easily done right on the derrick floor.

The Baker Drill Pipe Float does so much; saves so much; and costs so little that we suggest you...

PICK ONE UP AT YOUR SUPPLY STORE—TODAY

BAKER

OIL TOOLS, INC.

HOUSTON · LOS ANGELES · NEW YORK

Oil's ingenuity is going to sea

ALL along the Gulf Coast this spring there is a special flurry of activity and planning, much of it in an aura of great secrecy. The oil industry is preparing to go to sea in a hunt for oil with a variety of mechanical devices which would do credit to the scientific imagination of Jules Verne.

During the congressional debates, legal arguments, and political hoopla over ownership of the "oil-rich tidelands," the industry kept very quiet about offshore oil development. But it was studying and planning, patiently awaiting the day when ownership and administration of the Continental Shelf would be settled.

That day is now at hand, and the race is on to devise and build equipment to wrest the oil from this watery domain.

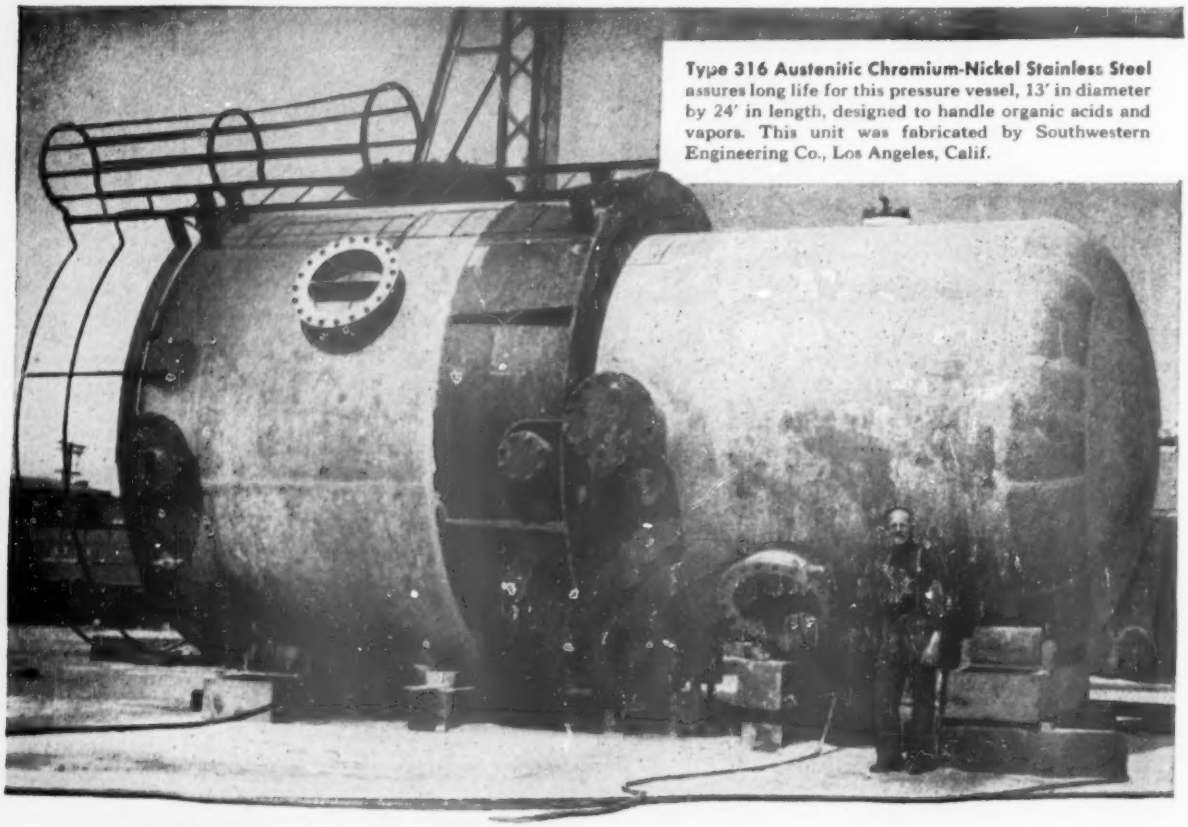
IT'S a blue-chip game and many a shirt may be lost, but that's the kind of gamble oil men love. They are morally certain that there is a lot of oil out there somewhere beneath the Gulf of Mexico, though they are prepared for as many dry holes and disappointments as are usual on land. But the special challenge is how to operate in 10 or 20 fathoms of blue water and withstand the fierce storms which blow up with tropical violence.

Before the political squabble over state versus federal ownership put a quietus on offshore work, the oil industry had learned enough about the Gulf of Mexico to whet its appetite and sharpen its ingenuity. It knew that oil could be found economically in deep waters only with some drilling platform less expensive than fixed pilings and more stable than shallow-water barges.

HERE is where competition is showing its worth. If a single organization, either governmental or private, had a monopoly on offshore oil, there would be a single development plan and a single experimental deep-sea barge. It might or might not prove effective. But with offshore oil now open to competitive enterprise, dozens of oil companies, shipyards, and free-lance inventors are pitting their wits against each other to devise successful new methods and equipment.

Some of the floating gear under consideration seems as fantastic as an interplanetary rocket ship. Only trial and error will determine whether or not it will work. Much money may be lost in this offshore oil game, but it will be money voluntarily gambled by private investors, not extracted from the sweat of taxpayers' brows.

Some of these venturesome enterprisers will succeed in extracting oil from the ocean depths at a profit which they will share with the taxpayers in the form of royalties. The consuming public will get the oil. And the competition to produce it will advance technology and keep the oil industry on its toes—as always.



Type 316 Austenitic Chromium-Nickel Stainless Steel assures long life for this pressure vessel, 13' in diameter by 24' in length, designed to handle organic acids and vapors. This unit was fabricated by Southwestern Engineering Co., Los Angeles, Calif.

Wherever you need

Exceptional corrosion resistance and improved creep strength...

Investigate Type 316 Stainless Steel . . .

It resists attack by organic acids, weak sulphurous acid, carbonic acid solutions and weak mineral acids. Also . . . to a good degree . . . sea-water.

The pressure vessel, shown above, is a typical application of Type 316 Stainless in the petrochemical industry where it is widely used to provide:

Resistance to corrosion (particularly, pitting)

Improved mechanical strength (particularly at elevated temperatures)

Ease of fabrication

Maximum economy per dollar

Increased equipment life

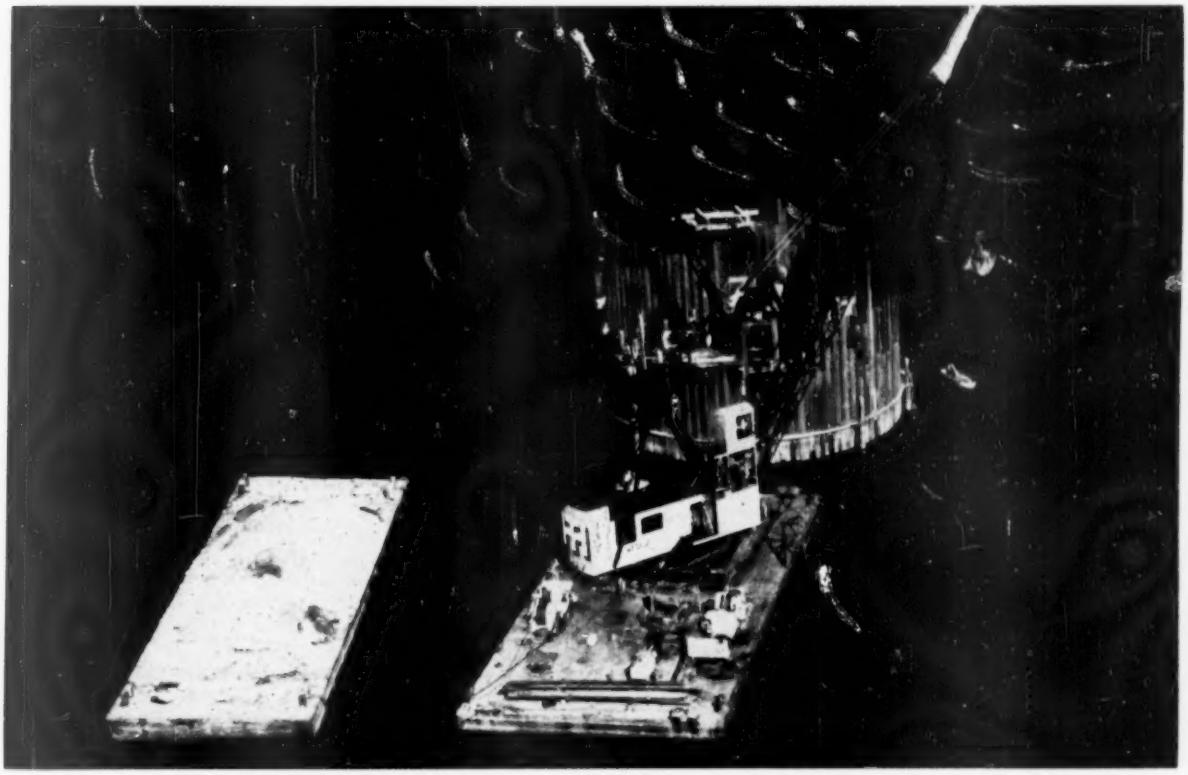
Type 316 Stainless contains 18 per cent chromium, 13 per cent nickel and 2 per cent molybdenum. It is one of some 30 alloy steels which qualify to carry the family name "Stainless" by virtue of their resistance to attack by chemicals and atmospheres over a wide range of concentrations, pressures and temperatures.

From among these stainless nickel alloyed steels, you can select exactly the right type for your specific needs. Leading steel companies produce austenitic chromium-nickel stainless steels in all commercial forms.

A list of sources of supply will be furnished on request.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

THIS WEEK... ...IN THE NEWS



CONCRETE CAP on this drilling island half a mile offshore from Seal Beach, Calif., is being poured this week as Monterey Oil Co. puts the finishing touches on the drilling island in 45 ft. of water. Spudding of the first of three wells to be drilled from the 75-ft. diameter structure is scheduled for late April. This picture was made while gravel was being dumped into the steel sheathing preparatory to pouring the concrete cap. For the phenomenal story of Monterey's rapid growth **see page 64.**

PIPELINES—Minnesota Pipe Line Co. expected to lay 156-mile crude line from Fosterton to Regina, Sask., as link with Interprovincial line to supply planned Great Northern refinery at St. Paul. . . . Final decision not yet made, but project may mean plans for Sioux pipeline system from Williston basin will be temporarily shelved. . . . ¶Products line from Laurel, Mont., to Glendive planned by Oil Basin Pipeline Co. . . . Construction to start as soon as weather permits. . . . ¶Work on Yellowstone line resumed after winter shutdowns. . . .

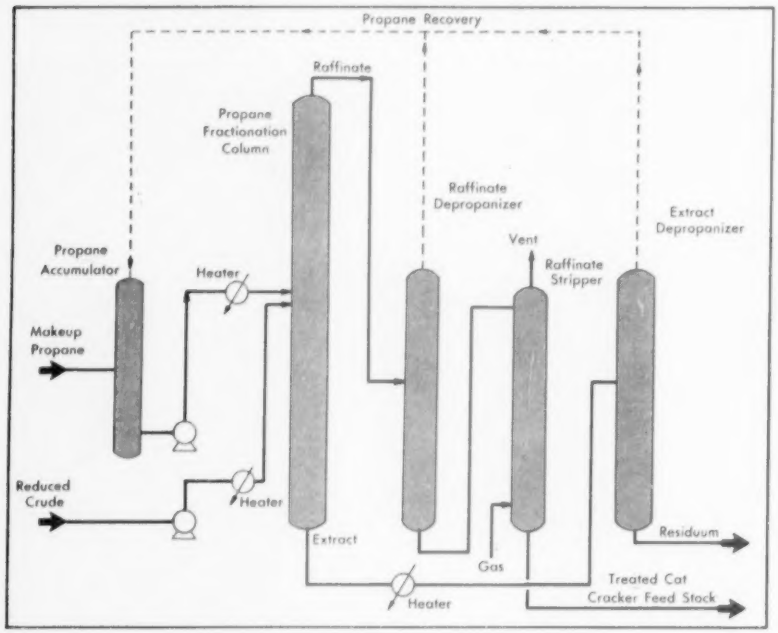
INTERNATIONAL—January world output drops less than 1 per cent because of Kuwait cutback as Saudi Arabia sets new production record. . . . ¶New Shell refinery at Geelong, Australia, goes on stream. . . . ¶Newly formed French oil group seeks Venezuelan concessions. . . . Venture is backed by Suez Canal Co. money. . . . ¶Esso Standard, only foreign company with French concessions, tests discovery in southwestern France. . . .

PROCESSING—Stanolind Oil & Gas takes over Carthage Hydrocol gas-synthesis plant at Brownsville by assuming $17,500,000 RFC loan. . . . Redesign of some facilities in $50,000,000 plant planned with rehabilitation work to begin about August 1. . . . ¶With household demands forcing natural-gas prices upward, coal, coke, and liquid petroleum hydrocarbons loom as future petrochemical base, ACS meeting speaker says. . . . ¶Refiners told bottom-of-the-barrel problems may be lessened by new process of preparing cat cracking feed stock from reduced crude. . . . ¶Price adjustment urged to close gap in products. . . .

GOVERNMENT—Battle lines are being formed in Congress for another fight to cut industry's depletion allowance. . . . ¶Eisenhower requests Justice Department consider Randall Commission antitrust recommendation. . . . ¶Control of gas distribution turned back to states from Federal Power Commission. . . .

ACTIVITY—Production of crude and lease condensate averaged 6,437,500 bbl. daily for week ended March 27, up 2,250 bbl. daily. . . . ¶Total completions decreased 9 wells to 979 for the week. . . . ¶Wildcat completions totaled 171 wells compared with 197 for previous week and 218 for same week last year. . . . ¶Rotary rigs operating in the United States decreased 98 rigs during week ended March 29 to 2,507. . . .

TRENDS—Total demand for gasoline has averaged about 3,300,000 bbl. daily since the first of the year compared with 3,151,000 bbl. daily last year. . . . The gain over last year was about 4.7 per cent. . . . These totals are on the old basis and include gasoline fractions blended to jet fuel.



New Feed Preparation

Cat cracking stock innovation outlined for chemists seen as aid in solving bottom-of-the-barrel problem

G. L. Farrar

KANSAS CITY.—A new process for preparation of cat cracking feed stocks from reduced crude was unveiled in a paper presented here during the 125th national meeting of the American Chemical Society, March 24-April 1.

The authors, P. H. Johnson, K. L. Mills, and B. C. Benedict, are with Phillips Petroleum Co., Bartlesville, Okla.

The process, which may help solve the refiner's bottom-of-the-barrel problem, has been tested extensively in the pilot plant. Gas oil is selectively separated from contaminants, aromatics, and asphaltenes by light hydrocarbon solvent fractionation, the authors said. Propane or isobutane is specifically recommended as the solvent, although other light hydrocarbons may also be used.

The authors said the process shows these advantages over the commonly used vacuum distillation process:

... **Marked reduction** in the metals content of the solvent-treated oil. Some metals, including vanadium and nickel, are highly deleterious to cracking catalysts. Consequently, considerable reduction in catalyst consumption should result when using the solvent-treated oils as cat cracking feed stocks.

... **Significant reduction** in the Ramsbottom carbon residue of the feed stock prepared by solvent fractionation. The carbon residue of a cracking stock is believed by many to appear quantitatively as carbon during cracking. Any reduction in carbon residue should reduce catalyst regeneration requirements at constant throughput and lead to longer catalyst life.

... **Lower aromatic content** results in the oils prepared by solvent fractionation, as compared to the oils prepared by vacuum distillation. This reduction further reduces catalyst regeneration requirements.

... **Rejection of nitrogen and sulfur compounds** is greater in the solvent fractionation process. Sulfur has many deleterious effects on the cracking operation, including modification of catalyst selectivity, reduction in lead response of gasoline stocks, contamination of olefin byproduct streams, and corrosion of equipment. Nitrogen is considered as a temporary catalyst poison.

... **Much less carbon and more gasoline** are produced in cracking the solvent-fractionated oils. Cat cracking conditions used in the comparison tests are typical of those commonly used in cracking such heavy oils. The solvent stock produced 54 per cent less carbon when using Panhandle crude and 35 per cent when using western Kansas crude.

Oils used in this cracking evaluation would normally represent approximately 10 per cent of the fresh feed to a cat cracker. Substitution of solvent-fractionated oil, barrel for barrel, for vacuum-flashed oil would reduce coke deposition and increase the gasoline

YIELDS USING NEW PROCESS

Reduced crude source—	Western Kansas		Panhandle-West Texas	
Cracking stock preparation method—	Solvent	Vacuum	Solvent	Vacuum
Yields, per cent of feed:				
Gas, C_3 and lighter, wt.	6.6	5.8	4.9	5.0
Propylene, vol.	4.2	3.3	3.7	2.9
Propane, vol.	2.6	2.8	2.1	2.1
C_4 unsaturates, vol.	5.5	4.9	6.6	5.4
C_4 saturates, vol.	4.6	5.1	5.4	5.0
C_5—400° F. e.p. gasoline, vol.	46.0	44.8	47.4	44.5
Conversion, per cent	57	57	57	57

PROPERTIES OF FEED STOCKS

Reduced crude source—	Western Kansas			Panhandle-W. Texas	
Reduced crude, vol. per cent of crude		15.4		7.0	
Cracking stock preparation method—	Untreated	Solvent	Vacuum	Solvent	Vacuum
Cracking stock, vol. per cent of crude		7.8	7.9	3.8	3.7
Properties:					
Gravity, °A.P.I.	10.3	20.8	18.2	23.2	20.5
Carbon residue, Ramsbottom, wt. per cent	7.5	2.31	4.23	1.88	4.58
Sulfur, wt. per cent	1.31	0.79	0.92	0.56	0.78
Nitrogen, wt. per cent		0.23	0.34	0.20	0.30
Metals, p.p.m.:					
NiO	68	0.9	2.8	1.1	7.1
V_2O_5	220	2.8	14.8	0.5	5.3
Viscosity, S.U.s., 210° F.	8,200	252	287	239	247

yield so that as much as 3,000 bbl. per day of additional gasoline could be made from a nominal 40,000-bbl. cracker, the authors said.

Detailed economic comparisons of the solvent fractionation process with the vacuum distillation process are not yet available. However, it is thought that the solvent process can be economically justified.

Process steps . . . In the solvent fractionation process, propane or other light hydrocarbon and reduced crude are heated and pumped separately to the fractionation column as shown on the accompanying simplified flow sheet. Ratio of solvent to reduced crude is variable, depending on the type of crude and the solvent. However, a ratio of approximately 6:1 has been employed successfully when using propane or isobutane.

Tower operating pressure is in the order of 1,000 psi.; tower temperatures are adjusted to obtain proper separation, depending on the solvent and reduced crude used. The tower used in evaluations made thus far is baffled over 50 per cent of the cross-section area, with baffles staggered throughout the tower.

Raffinate from the tower, containing the cracker feed stock, first passes to the raffinate depropanizer and thence to the raffinate stripper. Gas is used in the stripper to remove final traces of propane. Stripped oil is ready for use as cat cracker feed stock.

The extract from the fractionation tower passes through a heater to the extract depropanizer. Residuum from this tower is used for asphalt or other residual fuels production.

Propane recovered in the raffinate and extract depropanizers is returned to the propane accumulator to be used again in the process.

Petrochem Switch Seen

Expert tells A.C.S. delegates rising prices of natural gas will force industry to use other base feed stocks

KANSAS CITY.—Natural-gas prices are rising so fast that in a few years this raw material will be priced out of the market as a feed stock for petrochemical plants.

This was the opinion voiced here by Herman W. Zabel, executive vice president of Technical & Economical Services, Inc., New York engineering and consulting firm, during the national meeting of the American Chemical Society.

Zabel feels that a well-head price of 25 cents per M.c.f. is the point at which conversion to other feed materials will begin to take place in earnest. Coal, coke, liquid petroleum hydrocarbons, and other raw materials become competitive with natural gas at about this price, he said.

Increased demand for gas by householders is causing the rising gas prices, he said. Householders will pay premium prices for this clean-burning, trouble-free fuel, but the chemical companies will not, he added.

Other feed stocks . . . The chemical industry is highly competitive and every step from raw material to finished product is subjected to constant cost scrutiny. Petrochemical processes in general which now use natural gas as feed stock may be adapted to use of coal, coke, or liquid hydrocarbons as raw material with little or no processing difficulty. Plants will switch feed stocks when it becomes economically feasible to do so.

In fact, he said, existing plants can in the main be changed from natural gas to other feed, with "very major portions" of the equipment suitable "as is" for the new processing requirements.

A direct corollary of this change in feed stock will be the location of new chemical plants in the East and Midwest, close to the big labor markets and the bulk of the consumers, rather than the Gulf Coast and southwest, near the natural gas fields, he said.

Of course, Zabel said, discovery of one or more new gas fields the size of Hugoton field in West Texas, Oklahoma, and Kansas would in all probability halt or slow the gas price increase, thus nullifying or reducing the possibility of feed-stock conversion.

Ammonia switch . . . As an example to substantiate his conclusions, Zabel pointed to ammonia synthesis. At the moment it is less costly to manufacture ammonia from natural gas in practically all parts of the United States. However, it is extremely questionable wheher this situation will persist over the life of an ammonia synthesis unit.

Studies indicate, he said, that within a period of 10 to 15 years ammonia producers in many parts of the United States will find it prudent to shift back to coal.

Consideration should be given then to design of new ammonia plants so that the feed-gas-production section of a given plant can be most easily converted to the use of coal, Zabel said. No modifications are necessary in the other portions of an ammonia plant.

Equipment for feed-gas production by partial oxidation of natural gas with tonnage oxygen is most easily adaptable to the use of coal, he said. A large number of the ammonia plants now under construction are using the partial combustion method, and will thus be readily convertible to the use of coal.

The conversion becomes more attractive, Zabel said, when it is realized that the tonnage oxygen plant provides

SYMPOSIUM SPEAKERS at the meeting of the American Chemical Society in Kansas City included Herman W. Zabel of Technical & Economic Services, Inc., New York, left, who spoke on designing for plant flexibility; Henry C. McGrath of M. W. Kellogg Co., New York, center, chairman of the design session; and D. J. Bergman of Universal Oil Products Co., Des Plaines, Ill., right, who spoke on designing for flexibility in oil refineries.

a stream of liquid nitrogen simultaneously with the production of oxygen, and that this nitrogen stream is an ideal means for removing final traces of such materials as carbon monoxide, carbon dioxide, and sulfur compounds.

These extraneous materials poison the catalyst in the subsequent ammonia-producing reaction. Thus, low-grade coal containing sulfur and other impurities may be utilized for ammonia production.

The ideal time table then for a new ammonia installation Zabel said, seems to be:

. . . **Start up the plant** on natural gas using oxygen conversion.

. . . **Use natural gas** as raw material until the price rises to the point when use of coal becomes economic.

. . . **Double the size** of the oxygen plant and install the other necessary equipment for manufacture of the required feed gas from coal, Zabel said.

NEW OFFICERS of the Western Petroleum Refiners Association reelected at San Antonio are, left to right, H. J. Kennedy, Houston, Continental Oil Co., vice president; J. W. Vaiden, Tulsa, Skelly Oil Co., vice president; Roland V. Rodman, Oklahoma City, Anderson-Prichard Oil Corp., president, and Reid Brazell, Alma, Mich., Leonard Refineries, Inc., vice president. Another vice president, F. L. Martin, Corpus Christi, Suntide Refining Corp., is not pictured.

Problem in Products

Price adjustments needed to cut down excessive gasoline stocks, increase output of other fuels, W.P.R.A. is told

George Weber

SAN ANTONIO, Tex. — Excess refinery capacity and the wide gap it has created between production of low and high-value products shared attention with a broad technical program here last week as the Western Petroleum Refiners Association held its 42nd annual meeting.

Appraising the industry's general outlook, Roland V. Rodman, president of Anderson-Prichard Oil Corp., found it good. He predicted the oil industry is not likely to be much affected by a moderate business decline in 1954.

However, the W.P.R.A. president warned that the refining industry must face the problem of excessive gasoline stocks and corresponding inadequate supplies of other products. This must be corrected, he said.

"Even if industrial activity declined slightly in 1954, the petroleum demand could conceivably rise since more than one-half of the use of domestic oil in recent years has gone for cars, trucks, and home use," Rodman declared. "Therefore even though automobile production and home construction should decline, the total number of cars on the road and the total number of households will, in all likelihood, continue to increase.

"But, however favorable the underlying demand may be, current problems are none-the-less serious," the association president said.

Rodman said it is impossible for the industry to remain sound while producing great surpluses of one product and inadequate supplies of another. A proper price relationship must be established between products, dictated by both products demand and economics.

A better price adjustment is needed, not only between different products such as gasoline and heating oil, but also between the two grades of gasoline, Rodman said. He pointed to a fact which refiners well appreciate—as gasoline octanes rise, the differential between manufacturing costs of regular and premium grades becomes greater and greater.

He said a complete restudy of cost and price differentials between the two grades is now in order.

It is apparent, Rodman concluded, that the refining industry must concern itself with the following four points:

. . . **Maintaining a healthy competition** and keeping pace with the growth and development of America.

. . . **Use of refining capacity** to take care of obligations to distributors—never to permit materials to be bootlegged to contracted accounts of others.

. . . **Value relationships** between products made from a barrel of crude oil must be such that there will be no shortages of one product and surpluses of another.

. . . **Gasolines of sufficient octane** to meet the needs of today's motoring must be made, but at the same time a realistic eye must be kept on the cost of such products and the value established accordingly.

How to make octanes . . . The outstanding technical session held during the 3-day meeting reflected the refiners' current concern with product improvement and a higher realization from the bottom of the barrel.

Both in and out of the formal sessions talk was of octanes. The competitive urge to lead the octane parade will push the octane level upward during the coming motoring season, in what seems likely to be an octane race in the true sense of that word.

By using some alkylate this season and relying on new catalytic reforming capacity now building, some majors are reported planning to market premium and regular grades of 97 and 91 research octane respectively in certain areas of the country.

Not to be outdone, numerous independents who have led in adopting catalytic reforming, are planning to up their octane ratings to match or exceed those of competitive majors in their marketing areas.

While the "race" is deplored as indefensible, the competitive factor appears to have an upper hand at least for the present.

Hydrogenation next . . . With catalytic reforming receiving its greatest impetus this year, another dimension in processing appears on the horizon. Hydrogenation has intrigued oil research

teams for years, but the many benefits derived thereby have thus far proved too costly for widespread commercial application.

Two factors now bring hydrogenation into proper economic focus—the availability of low cost by-product hydrogen from cat reforming and improved catalysts which will permit the operation at less severe and less costly conditions.

An example of the new hydrogenation processes now commercially available, is Unifining. In a joint paper presented by representatives of Universal Oil Products Co. and Union Oil Co. of California, the versatile features, and the economics of Unifining were outlined.

By the addition of hydrogen to hydrocarbons containing sulfur, nitrogen, oxygen and certain metals, these undesirable contaminants can be removed. Olefins and diolefins produced in cracking of petroleum fractions, can also be saturated.

These reactions, carried out in the Unifining process employing a cobalt molybdenum catalyst, promote:

. . . **Improvement** in odor and color stability.

. . . **Pretreatment** of catalytic reformer charge stock.

. . . **Reduction** in sulfur and nitrogen compounds.

. . . **Improvement** in burning qualities, cetane number and susceptibility to catalytic cracking.

The process is applicable to the processing of light, middle and heavy distillate stocks, the authors said. Altogether, eight units are now slated. One is in commercial operation and the remainder are in the construction or design stages.

New directors . . . New directors elected by the refiners included W. J. Carthaus, Great Northern Oil Co., St. Paul; W. H. Garbade, Deep Rock Oil Corp., Tulsa; L. L. Leabo, Bay Petroleum Corp., Denver; E. B. McConnell, Standard Oil Co. (Ohio), Cleveland; Bruce H. McCully, Cooperative Refining Association, Kansas City; A. F. Reed, Lion Oil Co., El Dorado, Ark.; J. B. Smith, Sunray Oil Corp., Tulsa, and C. C. Tate, Phillips Petroleum Co., Bartlesville.

Weeks Says Outlook Good

SAN ANTONIO. — "The reliable, time tested business yardsticks measure a moderate decline in business activity. None of them indicate an approaching emergency," Secretary of Commerce Sinclair Weeks told the closing session of the Western Petroleum Refiners Association here last week.

He said, "In fact, most of them reveal exceptionally strong stability which, had we not experienced an all-time boom in 1953, would be taken as evidence of solid prosperity."

Weeks reviewed plant and equipment expenditures by the petroleum manufacturers during the past 8 years, and reported that a joint survey with the Securities and Exchange Commission shows that expectations of new capital outlays for industry as a whole this year are down 4 per cent while petroleum industry expenditures are expected to be about 4 per cent over 1953 (*The Oil and Gas Journal, March 22, page 115*).

He predicted that a projected federal road building program will consume great quantities of asphaltic materials produced from petroleum, and that the petrochemical industry will continue to open up new areas for sale of fibers, plastics, and other new petroleum by-products.

Fuel-Saving Idea

Blending of more butane into summer gasoline instead of burning it under boilers means extra cash, W.P.R.A. told

F. Lawrence Resen

SAN ANTONIO. — Refiners could save $100,000,000 a year by blending more butane into motor gasoline during the summer.

Butane amounting to at least 4.2 per cent of gasoline produced during the six warmest months could be blended without increasing the incidence of vapor lock, T. W. Legatski and H. J. Elder, both of Phillips Petroleum Co., told the Western Petroleum Refiners Association meeting here.

As it is, the butane probably is burned under refinery boilers, they said. The $100,000,000 saving, they figured, is due to the fact that 4.2 per cent of gasoline production amounts to about 25,000,000 bbl., and that the difference between gasoline and boiler-fuel value is about $4.20 a barrel.

If anything, they said, the $100,000,000 figure is conservative, since there is much evidence to indicate that butane equivalent to as much as 6.3 per cent of summer gasoline production can be blended into motor gasoline without increased vapor lock.

Survey made . . . These conclusions were drawn from a survey made during the three summer months of 1953. Samples of filling station motor gasolines were obtained, and Reid vapor pressure determinations and A.S.T.M. distillations were carried out. Reid vapor pressures and 30 per cent point temperatures from distillation tests were crossplotted to determine pressure-temperature patterns.

Experience indicates, the authors said, that proper control of these two factors is sufficient to regulate gasoline vapor characteristics for general service use. No consistent pattern of relationships was apparent in any of the survey areas, and quite large differences were noted.

A family of curves expressing the general relationship between vapor pressure, 30 per cent evaporated temperature point, and butane added, were drawn. Also added to this plot were three curves which were, in effect, iso-vapor-lock guide lines. All fuel compositions which fall along any one of these lines represent equal vapor-locking tendencies when used in cars having fuel-system vapor-liquid handling capacities of the order of 30 to 1.

Most fuel systems can continue to meet engine requirements when the ratio of gasoline vapor to gasoline liquid at the pump inlet is 30 to 1 or even higher. These iso-vapor-lock guide lines are designated as "Prevailing Practice," "More Conservative" and "Less Conservative."

The over-all composition of motor gasolines, both premium and regular, were examined and the conclusion was reached that an additional 4.2 per cent of butane could be blended on the average during the summer months without increasing the incidence of vapor lock. This addition would cause the final products to fall along the "Prevailing Practice" iso-vapor-lock guide line.

However, it was pointed out that the "Prevailing Practice" guide line is not a limit and there is a substantial amount of information available which indicates all refiners could go to the "Less Conservative" guide line without encountering difficulty. If this line were generally adopted in a blending pattern, the increase in the butane content of average summer gasoline would be about 6.3 per cent instead of the previously calculated 4.2 per cent, they said.

Stanolind Takes Plant

Firm assumes loan on Carthage Hydrocol gas-synthesis operation, hopes to have plant working by late next year

BROWNSVILLE, Tex.—Stanolind Oil & Gas Co. has taken over the huge gas-synthesis plant here of Carthage Hydrocol, Inc., and expects to have it in operation again late next year.

Stanolind last week exercised its option to acquire the plant by assuming responsibility for a $17,500,000 loan granted Carthage by Reconstruction Finance Corp.

E. F. Bullard, Stanolind president, also announced that his company is acquiring the U. S. Industrial Chemicals Co. storage terminal here. It, together with the Carthage plant and a $15,000,000 Stanolind chemical plant adjacent to Carthage Hydrocol, will be operated as a single plant by Stanolind.

Contract for overhaul of the Carthage plant is expected to be let within the next few weeks, with work scheduled to begin by August 1. Stanolind plans to redesign and rebuild some units.

What is involved . . . The Carthage Hydrocol plant was designed to convert 90,000,000 cu. ft. of natural gas daily into about 7,000 bbl. of petroleum products and 300,000 lb. of chemicals.

It was built at an ultimate cost of $50,000,000 by nine companies, but never operated at more than a third of its capacity and was plagued by shutdowns throughout its active life. It has been idle since June 1953.

Early last November the nine stockholders announced they were writing off their entire investment in the project and turning it back to RFC, which granted a loan of $18,500,000, about $1,000,000 of which has been repaid.

Decision to abandon the unique synthesis plant was prompted by the prospects that at the then current rate of operation the project would never pay out. Participating companies, faced with the choice of either investing more money to bring the plant to capacity operation or canceling out their investment, chose the latter course.

Logical operator . . . Had Stanolind not taken over the huge Brownsville plant, it was expected that the facilities would have been scrapped.

Stanolind was the logical company to assume operation for two principal reasons:

. . . The same process used in the Brownsville plant was considered by Stanolind several years ago for use in a huge synthesis plant at Garden City, Kans. Rising gas prices and skyrocketing construction costs caused Stanolind to abandon this project, but not until exhaustive pilot-plant work on the process had been done.

. . . Operation of the Carthage plant is necessary to operation of Stanolind's Brownsville chemical plant. This plant was designed to process a byproduct chemical stream from the Carthage plant, separating and purifying chemical products. These included alcohols, aldehydes, ketones, and acids. With the Carthage Hydrocol plant shut down, the chemical plant, without a feed stock, would have been something of a white elephant.

Prospects . . . Bullard said his company is "confident" the synthesis plant "can and will ultimately be made to operate."

"We know the process is sound, for it has been proved again and again in our pilot-plant operations. It is a question of getting the right equipment installed to permit the plant to achieve capacity operation."

Stanolind officials said in spite of the long shutdown, the synthesis plant is in "pretty good shape" internally. The company plans to install a second synthesis-gas generator before attempting to put the plant on stream.

For the last 4 months the company has been under way on an intensive evaluation of the plant facilities. After starting the study, Stanolind let a contract to Lummus Co. for assistance in the work and later called on Hydrocarbon Research, Inc., for process design work in connection with the study.

The plant design called for yields of 6,000 bbl. of gasoline, 900 bbl. of diesel oil, 200 bbl. of fuel oil, and 300,000 lb. of chemicals. The process involves compressing 280,000,000 cu. ft. of air to —275° for separating the oxygen, then using this oxygen to burn 90,000,000 cu. ft. of gas to produce a synthesis gas.

This synthesis gas then is catalytically converted and the components reacted under certain conditions to produce petroleum hydrocarbons and aliphatic chemicals. This effluent stream is split into a hydrocarbon stream, which is fractionated conventionally into oil products, and a chemical stream, which is sent to the Stanolind plant.

The Texas Co. was the largest stockholder in the Carthage Hydrocol plant, owning close to 50 per cent of the stock. Other owners were The Chicago Corp., Forest Oil Corp., Hydrocarbon Research, La Gloria Corp., Niagara Share Corp., Stone & Webster, Inc., United Gas Corp., and Western Natural Gas Co.

Total investment in the plant reached $49,316,000, including the RFC loan and a $2,500,000 advance made by Stanolind for the chemical stream.

Upgrading Distillates

Additive permits flexibility in diesel-fuel manufacture

SAN ANTONIO.—More middle distillates can be utilized as good quality diesel fuels by using primary amyl nitrate as an additive, E. A. Desmond and G. C. Wilson, Ethyl Corp., Detroit, declared during a WPRA meeting here.

They based their conclusion on an investigation of over 300 compounds thought to have possibilities as cetane improvers.

One of the significant characteristics of the compound is the high boost obtained with the first small percentage added to the fuels, they said.

Secondary amyl nitrate has previously been investigated as a cetane improver.

They said availability of amyl nitrate as a diesel fuel ignition improver will permit a refiner to upgrade the ignition quality of available middle distillates that meet all the requirements of the engine operation other than the lack of adequate cetane number.

The additive also can assist the oil industr by:

. . . Permitting increased flexibility of refinery operations by reducing the need for controlling the natural cetane number of middle distillates to make diesel fuels.

. . . Permitting the selecting and blending of diesel-fuel components from the standpoint of other desirable characteristics, such as volatility, high volumetric heating value, and low pour point by providing another means of meeting cetane requirements.

. . . Providing considerable savings in some circumstances by consolidating the blending, distribution, and storage of diesel fuel and furnace oil stock as a single product. This stock would be satisfactory as a burner fuel as blended and would be made into a good diesel fuel by raising the cetane number to the desired level by adding the amyl nitrate at the marketing point.

Journal Adds to Editorial Staff

TWO additions to the editorial staff of The Oil and Gas Journal were announced last week by Kenneth B. Barnes, editor, as a part of a continuing move to further improve the editorial content of the world's largest business magazine.

The new Journal staff members are Norman S. Morrisey, formerly geologist and geophysical coordinator for Stanolind Oil & Gas Co., Oklahoma City, and Carl J. Lawrence, a senior member of the staff of the Tulsa World.

Morrisey will be drilling-development editor; Lawrence is district editor on the central news staff. Both will be headquartered in Tulsa.

N. S. MORRISEY

Morrisey is a 1942 graduate of Colorado School of Mines with a degree in geological engineering. He did graduate work in geology at Stanford University after the war and in 1950 received his M.S. in geological engineering from University of Tulsa.

His first work with Stanolind was as a scout, later serving as research engineer, subarea geologist, and geophysical coordinator. He is a member of the American Association of Petroleum Geologists, Society of Exploration Geophysicists, and the Oklahoma City Geological Society and the Geophysical Society.

During the war Morrisey served 3½ years as a meteorologist in the Navy, including 2 years abroad. Before joining Stanolind in 1947 he worked as a geophysical computer for United Geophysical Co. in Pasadena, Calif.

Lawrence has been a member of the Tulsa World staff for 6½ years. He is a graduate of Tulsa University with a degree in journalism.

C. J. LAWRENCE

For the past 2½ years he has been on special assignment for the Tulsa newspaper, largely handling business, finance, and real estate news, and serving for a considerable period as assistant city editor.

During the war Lawrence served 2 years with the Marine Corps, most of the period on overseas duty.

GULF COAST

Testing Station Operating

FREEPORT, Tex.—The first Gulf Coast testing station to study atmospheric effects on metals has been set up here by Dow Chemical Co.'s Texas division, the American Society for Testing Materials and the American Welding Society.

The station, near the junction of the Brazos River and the Intracoastal Canal, will perform long-range tests of metals, metal alloys and metallic finishes when exposed to the Gulf Coast's atmosphere. About 1,600 aluminum and magnesium alloy samples furnished by the A.S.T.M. have already been installed. They include riveted sections, welded sections, cast forms and extruded forms.

Four Firms Plan Venture

TULSA.—Four companies have reached a tentative agreement for exploration, leasing, and drilling submerged tracts off the coasts of Louisiana and Texas with Sinclair Oil & Gas Co. as operator of the joint venture.

The agreement was reached by Sinclair, Sohio Petroleum Co., El Paso Natural Gas Co., and Peoples Production Co., a subsidiary of Peoples Gas, Light & Coke Co., Chicago.

None of the four at present holds any offshore leases, and details of the arrangements have not yet been worked out.

H. B. Smith, president of Sinclair, said his company will open offices to direct the joint project in New Orleans within the next 30 days.

Fish Protection Assured

WASHINGTON.—Oil operators exploring the outer Continental Shelf off Louisiana will be required to comply with that state's requirements for the protection and conservation of aquatic life.

Under a cooperative agreement between the Interior Department and the Louisiana Wild Life and Fisheries Commission, the department has adopted as part of its regulations the rules and requirements of the commission governing geological and geophysical explorations in the submerged lands off the Louisiana coast.

The department announced last week that operators must confine explorations in those areas designated and approved by the regional oil and gas supervisor of the Geological Survey. Army Corps of Engineers approval also is needed along with filing a stipulation with the Louisiana commission agreeing to comply with its requirements.

CANADA

Three-Way Split Proposed

CALGARY, Alta. — Canada Southern Oils, Ltd., has proposed a reorganization in which its assets would be divided among Canso Oil Producers, Ltd., an oil production company; Canso Natural Gas, Ltd., a gas production company; and Canada Southern Petroleum, Ltd., an exploration company.

A "special general" meeting of stockholders of Canada Southern Oils has been called for April 20 here for a vote on the proposal. Under the proposed split, present Canada Southern Oils stockholders would receive four shares of Canso Oil, five shares of Canso Natural Gas, and eight shares of Canada Southern Petroleum shares for each eight shares of Canada Southern Oils stock.

In the reorganization, Canso Oil would acquire producing and partly developed properties of Canada Southern Oils located principally in the Smiley-Dewar-Coleville area in Saskatchewan, and related physical equipment and other assets.

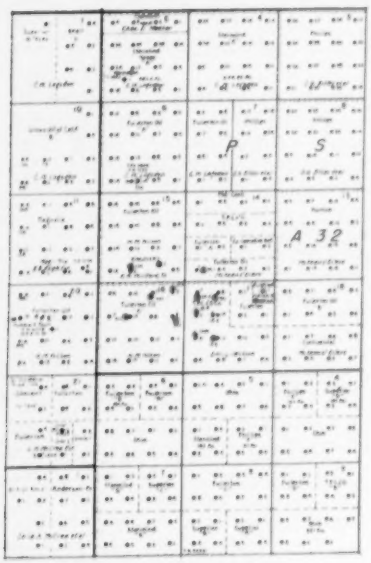
Canso Natural Gas would get interests in the natural gas contained in all the present properties of Canada Southern Oils located in Canada, with the exception of those in British Columbia where special problems of exploration exist.

Canada Southern Petroleum would get all other assets of Canada Southern Oils.

Oklahoma Interest Purchased

CALGARY, Alta.—Canadian Oil & Gas Co., a wholly owned United States subsidiary of Canadian Oil & Gas Reserves, Ltd., has purchased Margo Petroleums Corp. for an undisclosed sum.

Assets of Margo Petroleums are estimated to be worth about $500,000 in proved, semiproved, and potential oil land in Oklahoma. They include an interest in a 1,300-acre block in Okfuskee County which has four producing wells and a similar interest is a 1,200-acre block in Oklahoma County which has two wells.



FULLERTON'S principal properties are in this area of Fullerton field, in Texas.

H. C. PYLE
President

E. E. PYLES
Exec. Vice President

J. B. HUDSON
Vice President

Monterey Executives . . . and Their Record

Date—	Purchase	Price	Properties
Dec. 1950	Jergins Oil Co.	$29,000,000	California production and other assets.
Feb. 1953	Wilshire Oil, leases	Cash and oil	Texas, California leases.
Mar. 1954	Fullerton Oil Co.	$52,000,000	Texas leases and other.

Monterey—"Big" Producer in 3 Years

This young West Coast company will be well up the ladder as a producer with the purchase of Fullerton properties

D. H. Stormont

LOS ANGELES.—Monterey Oil Co. is only 3 years old, but it is already a substantial oil producer and will be considerably bigger when it completes its pending purchase of Fullerton Oil Co.

Expansion of oil-producing facilities through purchase of proved leases is by no means a new practice, but Monterey's record is the prime example on the current oil scene.

The company was started through purchase of Jergins Oil Co. in California. Besides California leases, properties acquired included stock interests in two instrument companies and the Jergins office building in Long Beach. Most properties have been disposed of by Monterey.

Next in the company's expansion was acquisition of oil properties of Wilshire Oil Co. in West Texas and California.

Latest and largest oil deal is the pending purchase of the stock of Fullerton Oil Co. Fullerton has a daily production of about 6,000 bbl. and its largest properties are those in Fullerton field of Andrews County, West Texas *(See map).*

Fullerton deal . . . Although some steps remain to be completed, Monterey is expected to acquire most of Fullerton's producing properties—a major stride in its expansion - through - purchase program.

If the desired 80 per cent of Fullerton stock is acquired by Monterey and "Eastern" financial institutions, it will be done with a minimum cash outlay. Outside capital will be repaid through long-term oil payments.

Reports on Spring Street last week were that about 75 per cent of the shares already had been placed in escrow. This practically assured deposit of 80 per cent of the shares before the April 15 deadline.

The entire transaction, a $52,000,000 deal, promises to be by far the company's largest in its 3-year corporate life. It is expected to be carried out along the lines followed in the acquisition of Wilshire Oil Co.'s properties last year.

When the offer to purchase the stock was made early in March, W. W. Valentine, Fullerton president, stated it was by eastern interests and Monterey, with Lehman Brothers advising on certain financial details. The other companies later were identified to be Alban Corp. and Church Oil & Gas Co. The offer of $71.50 a share was made when the stock was moving on the market at about $35 per share.

In the formal bid to stockholders it was pointed out the offer was until April 15, and that it was contingent upon deposit of 571,800 shares (80 per cent) of the stock with a Los Angeles bank.

Jergins purchase . . . Monterey was organized in December 1950 by Lehman Brothers for the purpose of purchasing the outstanding stock of Jergins Oil Co. This was carried out at a total cost of $29,000,000.

Principal property involved was a one-half interest in leases covering about half of San Ardo field. These were sold to General Petroleum Corp. in June 1952 for cash and oil payments totaling about $18,200,000. Output of the remaining Jergins properties taken over was about 8,000 bbl. daily, of which almost 7,000 bbl. was in California.

Other properties sold during the liq-

uidation included stock interests in Lomita Gasoline Co., $3,300,000; interests in two instrument companies, $3,601,000; and the Jergins office building in Long Beach and other assets, $2,228,000.

Wilshire purchase . . . In February last year a two-thirds interest in oil properties of Wilshire Oil Co., including 2,600 net producing acres and 57 net oil wells in California and Texas, was added to Monterey's holdings. Again Lehman and other eastern companies, as B-L & Associates, had acquired controlling stock interest (66.66 per cent) in established oil production and was turning over its operation to Monterey.

Net adjusted price to Monterey was $1,766,000, plus reserved oil payments payable out of about 85 per cent of the production. Monterey's interest, after deducting 5,827,780 bbl. to meet the oil payments, were estimated to consist of an oil and liquids reserve of 12,208,920 bbl.

In this manner Monterey achieved an important addition to its oil and gas reserves with minimum investment of cash. The 85 per cent of income set aside to meet the oil payments is expected to result in a payout by 1958. Meanwhile, based on current crude prices, the remaining 15 per cent is sufficient to defray operating and development costs of the properties.

The company . . . Current production of Monterey properties in Oklahoma and Texas is about 10,500 bbl. daily. This is an increase of 4,000 bbl. daily over that during the last half of 1951. If the company acquires all Fullerton properties as expected, it will have a total daily production of about 16,500 bbl.

H. C. Pyle, former president of Continental Consolidated Corp. and head of Jergins Oil Co. at the time of its sale, has guided Monterey's growth. E. E. Pyles is executive vice president, and J. B. Hudson is its new vice president in charge of exploration and production.

Oil reserves of Monterey at the close of 1953 were estimated to be 43,700,000 bbl. Of these 22,000,000 bbl. were in the Edison field and an additional 10,000,000 bbl. were in other California fields.

Two offshore leases of Monterey are expected to add materially to tfiese oil reserves. Offshore from Seal Beach the company, jointly with The Texas Co., has a 1,125-acre lease which already has been proved productive by a 12,000-ft. slant hole bottomed 1½ miles from shore. First of three wells to be drilled from a $1,000,000 man-made island being built almost over the bottom of the slanted well is scheduled to get under way late this month or early in May.

Jointly with Humble Oil & Refining Co., Monterey has a contract with Newport Beach for development of 1,640 acres of submerged lands. Last December the company proved this offshore acreage productive by slanting a well from an upland location. Last week, following completion of a second well as a 100-bbl. pumper, drilling was suspended for 60 days to permit more study of the area.

Reserves of Fullerton are not disclosed but in its recent annual statement it was brought out that 1953 crude output averaged about 6,000 bbl. daily. Bulk of its production is in Texas fields. Its reserves in the Fullerton field are expected to be materially increased by means of the unitized pressure maintenance program to be started there.

In a prospectus dated March 3, Lehman Corp. and associates offered 257,338 shares of Monterey stock for sale. The shares represented about 22 per cent of the total outstanding. None so far have been recorded as having been traded.

Fracturing Report

Model studies show what can be expected from treatments; type of fracture may depend on depth, meeting is told

WICHITA FALLS.—Recent developments in fracturing techniques and best methods of preparing for water flooding were among the technical subjects discussed during the annual meeting here of the North Texas Oil and Gas Association.

Formation fracturing research being conducted by the Texas Petroleum Research Committee is yielding data for estimating the effect of fractures on well-producing rates, water-flooding, and gas-cycling operations, it was reported by Dr. Paul B. Crawford, assistant director, College Station, Tex.

Calculations from model studies indicate creation of a fracture extending approximately 100 ft. from a clean well flowing at a steady rate in a 10-acre spacing will result in a flow rate of approximately 5.7 times the rate of production prior to fracturing for the case of circular or elliptical horizontal fractures, he said.

Crawford said an inclined fracture under the same conditions will increase the flow rate 4.8 times and a vertical fracture will increase it 3.2 times.

In a line-drive pattern, Crawford said, if a vertical fracture exists half the distance between wells, the sweep efficicacy when flooding or cycling may be near 28 per cent if the flood is conducted parallel to the fracture and 85 per cent if the flood is perpendicular to the fracture.

Another research conclusion is that circular horizontal fractures of 150-ft. radii at all wells in a 10-acre pattern are expected to result in sweep efficiencies of 56 per cent for a five-spot pattern, 40 per cent for a line drive, and 58 per cent for a seven-spot pattern. Fractures of 150 ft. are expected to reduce the break-through time by factors near 8 to 10, he added.

Desirable fracture radii are indicated to be near 30 to 50 ft. for 10-acre well spacing, 40 to 75 ft. for 20-acre spacings, 60 to 110 ft. for 40-acre spacings, and 225 to 425 ft. for 640-acre spacings.

Flowing water key to oil . . . Better knowledge of tilted water tables will help find more oil and clear up some mysteries about certain types of oil and gas fields, Dr. M. King Hubbert, of Houston, chief research consultant in general geology for the Shell Oil Co., told the association.

Because it is common to find the layers of oil, gas and water in a reservoir each resting at a level, Dr. Hubbert said, oil men are missing many reservoirs where the fluids are not in their customary relationship and positions.

Normal conditions prevail where the ground water is stationary, forming a hydrostatic trap, he explained. Often the water is flowing through the formation, causing the oil and gas to collect in unexpected places known as hydrodynamic traps, he said.

He said almost since the beginning of exploration, geologists have worked on the theory that oil and gas will be found in a horizontal position at the tops of anticlines or at the highest place in a formation to which it can be pushed by the formation water. This theory is valid only when the water is at rest, he said. When water is flowing through the oil-bearing sands, oil and gas may accumulate at places other than on the crest of an anticline, he added.

Among the examples of hydrodynamic traps cited by Dr. Hubbert were Hugoton gas field in Kansas, Wheat oil field in West Texas, and Frannie field in Wyoming. In all of these, the contact between water and oil or water and gas is tilted, he said.

Fracture figures . . . The weight of the overburden is the answer to the controversy as to whether formation fracturing creates vertical or horizontal fissures, it was asserted by J. H. Prusick, research director of Orchem Corp., Austin.

He presented a paper on "The Use of Emulsions and Related Techniques in the Treatment of Oil and Gas Wells." It was coauthored by Zane V. Morgan, development engineer, Texas Acidizers, Inc., Seguin, Tex.

Prusick said horizontal rupturing takes place in wells of about 1,500 ft. or less while vertical fractures are indicated in wells bottomed between 1,500 to 6,000 ft.

These conclusions are based on the amount of shale recovered from the return flow after treatment, he said.

"Below approximately 6,000 ft., generally poorer results are obtained and it is probable that due to overburden pressures the fractures do not open wide enough to receive a heavy concentration of injected sand to achieve an effective flow system," Prusick said.

The prejudice of most oil producers against emulsions in their wells held back the use of certain types of fluids for formation fracturing, but it is now being realized that some emulsions are excellent for fracturing and do not interfere with oil production, Prusick said.

He said a new water-in-oil type of emulsion has been developed that holds the sand well and is highly satisfactory from the standpoint of the service company.

Acidizing report . . . In discussing acidizing, Prusick said that recently the use of new chemical additives to hydrochloric acid has made it possible not only to improve acidizing methods in general but also to permit successful acidizing of sand formations containing calcareous material as well as straight sand formations.

He described one such additive developed by his firm which serves as a silt-suspending aid and as an anti-clay-swelling agent, explaining that this prevents mechanical plugging of the capillary channels by silts and insoluble materials released by the acid reaction.

Another additive plates a protective molecular film on bentonitic clays to aid the flocculating effect of strong acid, lower the surface tension of the treating acid, and act as an emulsion breaker.

Water blocks which often reduce the productive capacity of old and new wells can be cleared by a new reservoir-conditioning treatment, he explained. This is a specially designed oil-soluble wetting agent which will preferentially oil-wet the reservoir capillary surfaces with the treated area and break down and remove water blocks.

Water-flood hints . . . Paul J. Shanor, division engineer of Bradley Producing Corp., Tulsa, told the association his first advice to an independent operator for evaluating water-flood potentialities of a property is to disregard all oral reports and hot-shot prospects and make a careful study of the key factors governing water flooding.

Shanor offered a four-point check list on what he termed the most obvious factors to study before even thinking about a pilot flood or unitization agreement. He divided the list into reservoir characteristics, nature of the reservoir fluids, production history of the area by leases, and economic factors.

Some water floods have not paid out, he said, because the reservoir was not continuously connected or because the thickness of the floodable pay zone was not as great as indicated by drillers' logs. The two most important factors, porosity and permeability, cannot be determined without core analysis, he said, although a reasonable estimate can sometimes be obtained by comparisons with similar sands.

Shanor stressed that no guarantee can be made on the success of water flooding, but said many costly failures can be avoided by detailed preliminary studies.

Refining Cut Urged

Thompson sees trouble in gasoline excess; high imports attacked by I.P.A.A. official during North Texas meeting

Henry D. Ralph

WICHITA FALLS. — Warnings that refiners must cut their runs to work off excess inventories of gasoline and that imports of oil are still too high were sounded by speakers at the annual meeting of the North Texas Oil and Gas Association here.

Ernest O. Thompson, chairman of the Texas Railroad Commission, said a big trouble with the oil industry in this country today is that refiners have forgotten why they built so much new refining capacity.

He explained the refining industry was asked to build 1,000,000 bbl. per day of reserve capacity as a national defense measure and was given a special privilege of writing off the amortization for tax purposes in 5 years.

"Of course, as soon as these new facilities were built the refiners had to put them on stream to see if they would work properly—but they forgot to shut them off," Thompson said.

Thompson said refiners should remember that the new capacity was constructed as a standby measure for a national emergency, adding that producers are carrying 1,000,000 bbl. per day of reserve crude capacity as an adjunct to the refining buildup.

Due to the operation of these refineries, gasoline stocks have become excessive and are far above the anticipated demand for this year, Thompson said. He declared the industry is facing trouble if U. S. refiners continue to produce more gasoline than is demanded.

Problems cited . . . Thompson predicted a favorable future for the industry, but listed a number of problems and factors that will influence the course of the industry in this country. These include:

. . . Competition in the sale of refined products will be much keener due to the excess producing capacity, the continued race to provide higher octane gasolines, and the entrance of new companies into established marketing areas.

. . . Investment in new petroleum facilities will continue at a high level. Outlay for drilling wells on proven properties may be curtailed due to the current oversupply of crude, but leasing and exploratory work will continue at a fast pace.

. . . Expenditure on research of all types will be continued, with special emphasis on techniques of reducing the cost of finding and producing oil.

. . . The possible resumption of operations in Iran during 1954 may cause some curtailment in output in other Middle East countries and Venezuela—and could adversely affect the United States.

. . . Rapid development of new reserves in Canada and the operation of crude-oil pipelines in Vancouver and eastern refining centers will reduce Canadian oil purchases from the United States and other countries.

Imports excessive . . . Current oil im-

ports are between 200,000 and 300,000 bbl. per day too high, according to Minor S. Jameson, assistant to the president of the Independent Petroleum Association of America.

Jameson said he based his estimate on the imports excess on three different types of measurement, which he called the "domestic availability test," the "ratable taking test," and the "capital expansion test."

Jameson, urging that the industry continue to make an active study of the imports problem, said it will be present for a long time. He cited figures that show foreign oil-producing capacity from 1946 to 1952 exceeded foreign oil consumption by 1,482,000 bbl. per day.

"Along with hunting for oil, the imports problem seems to get more difficult each year," he said. "It would seem that an industry which has found 50 billion barrels of new crude-oil reserves in the last quarter of a century, at depths of over 17,000 ft., should be able to tell a 'supplement' from a 'supplant.'"

Noting that 1954 imports are forecast at 1,100,000 bbl. per day, an increase of 4.6 per cent over 1953, Jameson evaluated this on the three different bases:

. . . Domestic availability test. Assuming the domestic market should be supplied by domestic crude while maintaining a reserve producing capacity of 1,000,000 bbl. per day, Jameson calculated that imports are excessive by about 245,000 bbl. per day.

. . . Ratable taking test. On the assumption that imports should be reduced in the same ratio that domestic production is curtailed in periods of excess availability, Gulf Oil Corp. in 1950 announced a reduction of 10 per cent in its imports, Jameson said. On this formula, imports are now excessive by 210,000 to 218,000 bbl. per day.

On a somewhat similar formula offered by the I.P.A.A. in 1953, imports are excessive by 287,000 to 295,000 bbl. per day, he said. Still another version of the ratable-take test shows imports are excessive by 50,000 to 100,000 bbl. per day, he said.

. . . Capital expansion test. How much capital will be needed for expansion of the domestic industry and how much will be generated by the sale of crude oil could be calculated in various ways, Jameson said. Forecasts are that in 1954 the industry will drill virtually the same number of wells as in 1953, he said. Drilling has increased an average of 2,850 wells every other year since the war, he added.

Sioux Line Out?

Fosterton link favored over 12-company project

HOUSTON. — Minnesota Pipe Line Co. is expected to go ahead with plans to lay a 156-mile crude-oil line from Fosterton to Regina, Sask., as a link to the Interprovincial - Lakehead pipeline system to transport crude to a 20,000-bbl. refinery planned in the Twin Cities area by Great Northern Oil Co.

A Great Northern official here revealed the Minnesota Pipe Line project will probably be selected in preference to a joint project involving 12 companies. The latter project, known as the Sioux pipeline system, calls for laying a new line from the Williston basin to the Minneapolis-St. Paul area.

Final decision on which project will be undertaken has not been made, but a Great Northern official here said his firm has decided the Sioux system "is premature for the limited oil reserves discovered to date in the Williston basin." A decision is expected by April 10.

A committee representing the 12 companies interested in the Sioux system has appointed the Shell Pipe Line Corp. to study the economic feasibility of a new Williston basin-Twin Cities area line. Shell's report is scheduled to be made to the operators' committee around May 1 *(The Oil and Gas Journal, December 21, 1953, page 112).*

Great Northern plans to go on stream in late 1955 with the new refinery.

Refinery bids . . . In St. Paul, President William J. Carthaus of Great Northern reported that five refinery construction firms plan to bid on construction of the new plant. Bids will be submitted in May and the contract awarded late in the month. Preparing bids are Fluor Corp., Ltd., Bechtel Corp., Refinery Engineering Co., Blaw-Knox Co., and Lummus Co.

Woodley Canadian Oil Co. is to supply 30 per cent of the crude, Southern Production Co. 20 per cent, and the remaining 50 per cent will be sold to the refinery by Socony-Vacuum Exploration Co., a subsidiary of Socony-Vacuum Oil Co., Inc.

Marlin E. Sandlin, of Houston, Woodley Petroleum Co. vice president and vice chairman of Great Northern's board of directors, said that while exact pipeline facilities have not been decided that shipments of Fosterton crude will be moved to the plant "in sufficient time to meet our operating schedules."

Sandlin said Minnesota Pipe Line, an affiliate of Great Northern, was formed to construct, own, and operate a crude line from a takeoff point on the Lakehead line to Great Northern's plant. The line would move Fosterton crude of Socony-Vacuum Exploration, Woodley Canadian, and Southern Production.

Petrox Introduced

Texaco puts new additive in new premium gasoline

NEW YORK.—The Texas Co. has introduced a new motor fuel additive, "Petrox," in its new premium gasoline, which the company says incorporates the benefits of high octane, clean burning, additive blends, plus reduction of engine wear.

Texaco does not say what Petrox is, except that it is a hydrocarbon compound derived from petroleum and containing no metals. In this respect it differs from phosphate additives used in some gasoline grades. The new additive is synthesized catalytically in a new plant at Texaco's Port Arthur, Tex., refinery.

Texaco's claims for the new premium gasoline, based on results of 53,000 hours of single cylinder engine tests—equal to 535,000 miles of multicylinder engine laboratory tests and 1,290,000 miles of road tests in passenger cars and trucks—are:

. . . Forty-five per cent less piston ring wear under severe high-speed driving than that recorded using another premium fuel.

. . . Improvement of 300 per cent in valve life and spark plug life under the same comparative conditions.

. . . Eighteen per cent less intake port deposits and 19 per cent less combustion chamber deposits.

. . . Predicted increase of 60 per cent in the maximum-performance life of an engine.

. . . Reduced octane requirement buildup in clean engines because of the cleaner-burning fuel blend.

The company said rust protection and stalling prevention components also are incorporated in the new fuel.

Texaco did not disclose the octane rating of the new premium gasoline, but refinery construction by the company might tend to indicate the rating is high.

Texaco has a total of eight new Platformers either under construction or planned at refineries in this country, with aggregate capacity of about 72,000 bbl. daily representing about 13 per cent of the company's total crude capacity. Platformers upgrade motor fuel refining fractions into higher octane fuels.

Flood Permits Asked

Texas Railroad Commission studying six injection plans for secondary recovery projects in West and North Texas

AUSTIN.—Plans for two more waterflood programs in a growing number of projects proposed for the Yates sand of Pecos Valley High Gravity field, Pecos County, West Texas, have been laid before the Texas Railroad Commission.

The two floods are planned by Buckles & Hostetler, Monahans, Tex., and Carmack Drilling Co.

The Buckles & Hostetler project involves flooding the Yates underlying an area of about 1,430 acres.

J. D. Hostetler, testifying at a commission hearing, said the 22 wells on the acreage currently are producing an average of about 1½ bbl. daily each. The Yates in the project area, he said, is about 90 per cent depleted under primary methods.

Hostetler estimated oil recovery under the flood program at an additional 2,232,000 bbl. Original oil in place he set a 5,040,000 bbl.

Plans call for use of six injection wells on a 20-acre, five-spot pattern and a closed injection system. Injection water would be obtained from a salt-water formation at 143 ft. and injected into the producing formation topped at 1,690 ft. at an initial rate of about 40 bbl. daily per well and under pressure of about 850 psi.

Carmack Drilling, according to G. L. Buckles, spokesman at a commission hearing last week, wishes to flood the Yates underlying its 140-acre Iowa Realty Trust lease.

The lease is about 90 per cent depleted, under primary methods, Buckles said, and the 13 wells now are averaging about 1 bbl. daily each. Cumulative production, he said, was 126,685 bbl. the first of March. The flood program would result in the recovery of an estimated 679,000 bbl.

This flood, too, would employ a closed injection system and a 20-acre, five-spot pattern. Initial injection rate would be about 200 bbl. per well per day at an initial pressure of 500 psi.

Callahan flood . . . The commission also is considering plans of Green & Sandefer, Breckenridge, Tex., to flood the 330-ft. Cross Plains (Cook) sand under 130 acres in Callahan County Regular field, Callahan County, North Texas.

Applicant would use a five-spot, 7-acre flood pattern and a closed system. The 25 wells on the acreage have produced an estimated 281,627 bbl. of oil to date. Original oil in place was estimated at 3,000,000 bbl., and that recoverable under the flood program at 520,000 bbl. Injection water would be obtained from salt-water sands at 410-430, 620-640, and 740-760 ft.

Keystone Colby . . . Plans for a third flood program were submitted by Richardson Oils, Inc., for the Colby sand underlying its 200-acre W. E. Baird lease in Keystone Colby field, Winkler County, West Texas.

Harold Stallings, engineer for Richardson, told the commission the project area is in the late stage of primary depletion. There are six wells on the lease, three more drilling, and three locations.

Cumulative production to February 1, 1954, he said, was 118,412 bbl. This should be almost matched by oil recovered under the flood program, he estimated.

The project calls for use of 3 injection wells, a 35-acre, five-spot pattern, and an open type injection system. About 250 bbl. of water daily from the Rustler formation would be injected in each well at an initial pressure of about 250 psi.

Ritchie . . . Star Oil Co. is seeking permission to flood the 5,600-ft. pay horizon underlying about 200 acres in Ritchie (upper conglomerate) field, Montague County, North Texas.

The company asked permission to inject from 900 to 1,000 bbl. of water under 600 to 1,000 psi. through one well into the pay which averages 131½ ft.

Sam Wood, spokesman for the applicant, estimated primary recovery from the reservoir at 294,000 bbl. He said flood results could not be estimated because the reservoir has "gone to pieces" and production has dropped from 20,000 to 4,500 bbl. daily in the past 5½ months.

North Ward Estes . . . Harlan Production Co. plans to flood the Yates sand under its 40-acre J. F. Hathaway lease in North Ward Estes field, Ward County, West Texas.

Testimony at a commission hearing on the project disclosed that the four wells on the lease are producing an average of 2 bbl. daily, and cumulative production to March 1 was 244,328 bbl. Additional oil recoverable through flooding was estimated at 488,720 bbl.—twice primary recovery. Two of the four producers would be converted to injection service.

Woodlawn Decision Pending

AUSTIN.—Texas Railroad Commission decision is not expected for at least 30 days on whether cycling or pressure-maintenance operations should be conducted in the Pettit producing formation of big Woodlawn field, Harrison County, East Texas.

Chief Engineer Arthur Barbek says the commission is now awaiting transcript of the voluminous testimony given recently during the prolonged hearings.

Two widely separated positions on the feasibility of such a program were taken at the hearings by the operators. *(The Oil and Gas Journal, March 15, page 97.)*

Stanolind Oil & Gas Co., the field's biggest producer, Warren Petroleum Corp., and a few others are arguing that cycling or pressure maintenance would be unjustified economically and impractical without unitization. They maintain unitization would be extremely difficult, if not impossible, because of the many divergent interests in the field.

D. E. and R. J. Whelan, among 24 independent operators pressing for a cycling order, asked permission for any operator to file briefs within 30 days after the transcript is prepared.

Air Injection Planned

AUSTIN. — Kirkwood & Co. and Nixon Oil Co. have asked Texas Railroad Commission permission to inject air into the 1,500-ft. producing formation in Cooksey field, Bexar County.

Representatives of both companies said the field is definitely a salvage proposition, with bottom-hole pressure averaging only 100 psi. They said the producing sand, 14 to 18 ft. thick, is loaded with oil but has no drive.

Air would be used for injection, they said, because natural gas is not available and water would not be economically feasible.

Gas Tax Hike Slated

Texas drops new levy for jump in production rate

AUSTIN.—Texas legislators apparently have just about abandoned their efforts for the present to obtain most of the revenue needed to boost salaries of teachers and state employes via a new tax on natural-gas-transmission operations.

It now appears the production tax on natural gas, presently 5.72 per cent of value at the well head, will be increased—probably to 9.06 per cent of value.

This provision was incorporated into HB 15, the Shivers administration tax bill sponsored by Rep. Joe Kilgore. The action was taken after testimony before the revenue and taxation committee by representatives of oil and gas companies and associations showed a majority felt the gathering tax as proposed would hurt them more than a hike in the production tax.

The revised version was passed by the House March 30 by a 110-34 vote with only minor changes.

A token tax aimed at the long lines, however, was reported favorably by the committee after a heated session. The bill, the gas-reserves-dedication tax bill introduced by Rep. George Hinson, was amended and reported out to test the validity of the tax as an alternate to the production levy.

Rate of the reserves-dedication tax was cut from 1 cent per M.c.f., as initially provided, to one-thirtieth of a cent, which would bring in an estimated $1,300,000 annually. The tax rate under the amended bill would be increased to seven-twentieths of a cent if the tax should be proved valid. This revenue would equal the $14,000,000 brought in annually by the hike in the production tax, which would then be voided.

Hearings on the production-tax section of the House bill were to begin before a Senate committee late last week.

Debate in the house on the amended Kilgore bill, which also would collect $3,000,000 and $8,600,000 in increased taxes on the beer industry and on corporation franchises, respectively, began March 29.

Tax Refunds Started

AUSTIN. — First refunds of about $25,400,000 collected by the Texas treasury under the voided gas-gathering tax have been ordered by Judge Jack Roberts of the 126th District Court here.

Thirteen cases were consolidated by Roberts and refunds totaling more than $6,000,000 ordered.

The refunds ordered were: Lone Star Gas Co., $1,631,122; Texas Gas Transmission Corp., $759,153; Cities Service Gas Co., $511,700; Natural Gas Pipe Line Co. of America, $1,269,927; Texas Eastern Transmission Corp., $619,108; Texas-Illinois Natural Gas Pipe Line Co., $1,273,316; Arkansas Louisiana Gas Co., $403,052; Arkansas Fuel Oil Co., $17,483; West Texas Gas Co., $110,519; Colorado Interstate Gas Co., $1,327,898; Jack T. Williams, $9,964; Consolidated Gas Utility Corp., $82,-392; and J. I. Roberts and C. H. Murphy, Jr., Arkansas-Louisiana Gas Co., $1,745.

Texas Plans Lease Auction

AUSTIN.—The University of Texas will auction off oil and gas leases on 131 tracts of land in 12 counties May 21. Four of the tracts will require drilling of wells within 6 months.

The acreage is located in Cooke, Winkler, Ward, Andrews, Crockett, Pecos, Irion, Reagan, Upton, Martin, Crane, and Ector counties.

WEST COAST

Ammonia Plant Fires Up

Brea Chemical's new $13,000,000 partial oxidation plant will add 235 tons daily to West Coast's ammonia output

LOS ANGELES. — Brea Chemical Co.'s $13,000,000 ammonia plant at Brea, on the eastern outskirts of Los Angeles, will soon add 235 tons daily to the West Coast's ammonia manufacturing capacity.

Boilers for the new plant were fired up at a special press preview late in March, seven months after ground was broken. It will go into full capacity operation sometime in June.

The new plant is the first major manufacturing operation undertaken by the Union Oil Co. subsidiary, although it has been marketing some chemicals produced by Union. These consist of sulfur, ammonium sulfate, and methyl and ethyl mercaptans produced at its Wilmington refinery.

A new carbon dioxide plant which will produce 70 tons of dry ice and liquid CO_2 also has been started adjacent to the ammonia plant. It is expected to be completed in July. In addition, a $2,500,000 nitric acid and ammonium nitrate plant will be added. Contract for its engineering was awarded in January to C. F. Braun & Co.

Although the new ammonia plant was built by the Amoniaco Corp., it will be operated by Brea under a long-term contract. It employs the conventional partial oxidation process and low pressure synthesis, the latter at about 3,000 psi.

Homer Reed, Brea president, said the produced anhydrous ammonia will be marketed as aqua ammonia. This will make the company the first major manufacturer to market the product in this form. The solution form of ammonia was chosen, he said "because we feel it has definite advantages, both in handling and in crop production."

New Look at Antitrust

President outlines foreign trade policy, asks Justice Department to restate laws governing foreign operations

WASHINGTON. — President Eisenhower has requested that the Department of Justice consider the Randall Commission recommendation in connection with its current study of the antitrust laws.

"The commission has pointed out that uncertainty as to the application of United States antitrust laws to the operations of American firms abroad is a deterrent to foreign investment," he said. "It recommended that our antitrust laws be restated in a manner which would clearly acknowledge the right of each country to regulate trade within its own borders.

"At the same time, the commission insisted that it should be made clear that foreign laws or established business practices which encourage restrictive price, production, or marketing arrangements will limit the willingness of United States businessmen to invest abroad and will reduce the benefits of such investment to the economies of the host countries," he said.

The President made the statements in a message to Congress, in which he submitted a broad program for dealing with foreign trade policy. The recommendations concerning antitrust laws are of direct interest to the oil industry in view of the pending "cartel" suits against some oil companies and the participation, at the request of the State Department, of American companies in a program to return Iranian oil to the world market.

In his foreign trade program, President Eisenhower recommended a 3-year extension of the Reciprocal Trade Agreements Act with three successive 5 per cent reductions in our present tariff over that period. His recommendations were based on the highly controversial report published last January by the Randall Commission on Foreign Economic Policy *(The Oil and Gas Journal, February 1, page 48)*

Reaction mixed . . . The reaction in Congress to the President's recommendations was about the same as reactions to the Randall Commission report—mixed. There are no indications that the President's program will go through Congress this year.

More likely is a 1 or 2-year extension of the present law, to give time for further studies. The Senate finance committee already has asked the Tariff Commission to make some surveys, on which it is to report by December 1.

Other recommendations contained in the President's message included:

. . . Tax relief recommendations which are embodied in the general tax-revision bill passed by the House last month and now pending in the Senate.

. . . Protection of domestic industry, calling for retention of the present escape clause and peril point provisions, although in the past President Eisenhower has rejected recommendations of the Tariff Commission for increases in rates when industries suffered from the impact of imports.

. . . Review of the General Agreement on Tariffs and Trade, to which the major nations of the world have become parties since 1948.

. . . Contribution by the United States toward greater stability of world prices of raw materials "by moderating or relaxing impediments to international trade, by encouraging diversification of foreign economies, by avoiding procurement practices which disturb world prices, by consultation with other nations, and by tempering the fluctuations in our own economy."

. . . Increased encouragement of investment in overseas production by our citizens and the nationals of other countries.

. . . Provision of technical aid, but not capital, for development programs abroad.

Gas Control Back to States

WASHINGTON.—President Eisenhower turned control of local gas distributors back to the states late last month by signing HR 5976. The bill exempts the Federal Power Commission from taking jurisdiction over companies taking gas from interstate pipelines for use within a single state.

"I have approved this bill because of my conviction that the interests of the individual citizen will be better protected when they remain under state and local control than when they are regulated and controlled by the federal Government," the President said in a formal statement as he signed the measure.

Eisenhower said if the new amendment to the National Gas Act proves to be a burden to the states that he will "promptly recommend that the Congress take whatever remedial action appears to be necessary."

Depletion Attack

Congressional battle over tax allowance looms again

WASHINGTON.—Members of Congress are lining up for another fight over the oil industry's depletion allowance.

The Treasury has made no recommendation for reducing the 27½ per cent allowance this year. The House ways and means committee and the House itself have also agreed to continue the present rate in the general tax revision bill now in the hands of the Senate finance committee.

Despite this lack of House and Treasury opposition, efforts will be made in the Senate to cut the allowance to 15 per cent.

Early in February while visiting Oklahoma, Sen. Wayne Morse of Oregon said he would vote against "deductions of the expense of drilling dry holes from income taxes."

Last month, Sens. John J. Williams of Delaware and George D. Aiken of Vermont sponsored an amendment to the tax revision bill to cut the depletion allowance to 15 per cent.

Steed against cut . . . In an appeal to the House to stand firm behind the 27½ per cent rate if the Senate adopts the amendment, Rep. Tom Steed of Oklahoma warned last week that any cut would imperil not only the wildcatter and the oil industry as a whole but our entire program for national defense.

The present provisions have withstood repeated attacks over a period of 28 years, Steed pointed out. There is no question that reduction of depletion provisions would cause a sharp cutback in drilling, with loss of revenue to state and local governments, a decline in income to businessmen and a reduction in employment.

It has not been the wealthy oil company, but the wildcatter "who has found the oil which has enabled this country to successfully fight two wars in an age when petroleum-powered weapons were indispensable," Steed asserted.

Answering a statement attributed to

Morse that he will vote "against Oklahoma's drilling dry holes at the expense of the people of Oregon," Steed cited Treasury figures showing that Oklahoma paid federal taxes of $656,000,000 last year compared with only $473,000,000 by Oregon.

"These facts lead one to wonder just who is paying federal taxes at whose expense," Steed commented.

Gas Sales on Rise

9.6 per cent sale increase tops 7,700,000,000 M.c.f.

WASHINGTON.—Natural gas sales of 100 companies under Federal Power Commission jurisdiction topped the 7,700,000,000 M.c.f. mark last year for an increase of 9.6 per cent over 1952.

The companies' natural gas operating revenues increased 19.3 per cent but revenues from manufactured gas operations declined 19.9 per cent, the FPC reported last week. Net income of the companies was up 9.6 per cent.

Total natural gas sales reached 7,716,606,000 M.c.f. in 1953 against 7,043,475,000 M.c.f. in 1952. Natural gas operating revenues were $2,325,010,788 against $1,948,709,755, and net income was $232,985,943 against $212,663,295.

The number of customers increased from 7,358,967 to 7,648,732 ultimate consumers and from 996 to 1,006 gas utilities in 1953.

Federal taxes increased 18.1 per cent from $145,962,994 in 1952 to $172,334,520 last year, while state and local taxes increased 9.5 per cent.

At the close of 1953, the companies' gas utility plant valuation was $6,978,000,890, less $1,443,227,499 reserve for depreciation and amortization, or a net of $5,534,773,391. At the close of 1952 it was $6,283,773,627 less $1,292,712,890, or a net of $4,991,060,787. *(For a similar report prepared by the American Gas Association, see page 156.)*

Foreign Aid Study Slated

WASHINGTON.—The Foreign Operations Administration will make a survey of refining and other major industrial projects in Western Europe and Africa that has been partially financed with $600,000,000 in U. S. funds.

Cornelius S. Snodgrass, formerly vice president of the Bechtel Corp., will head the team of seven engineering specialists who will analyze the projects, built under the Marshall Plan and succeeding aid programs. Snodgrass formerly served as assistant deputy administrator of PAW, as its first head. J. Ed Warren took over when Brown returned to his post as president of Pan-Am Southern Corp., and Joseph A. LaFortune, vice chairman of Warren Petroleum Corp., wound the show up.

In contrast with some of the other emergency organizations, PAD will be remembered as the agency which never issued an order that wasn't imperatively needed; imposed only those restrictions which could not be avoided and removed its controls at the earliest opportunity—voluntarily going out of business as soon as it could.

It would take quite a book—which is being written—to recite the problems and accomplishments of PAD, but so far as the oil and gas industry is concerned it is going out of business with cheers, not jeers, for what it did.

WATCHING WASHINGTON

Bertram F. Linz

Another "Last Word"

The Supreme Court, this week or next, may have another last word on the tidelands oil controversy.

It was generally considered the court had its final say March 15, when it denied the request of Rhode Island and Alabama for permission to challenge last year's law which gave the coastal states title to their offshore lands.

The two states, however, refused to accept the court's decision as final and last month filed appeals for reconsideration.

In view of the firm statements made by the court as to the complete authority of Congress to dispose of government property, it is generally believed the court will not entertain the state's appeal even though Rhode Island proposed to offer constitutional issues not raised before.

With the appeal for reconsideration, the issue no longer is whether the offshore oil belongs to the federal Government or the states but whether the right of Congress to dispose of government property is to be limited.

Cheers, Not Jeers

The Petroleum Administration for Defense, like the Petroleum Administration for War, has served its purpose and has become an item for inclusion history.

In the 3½ years of its existence it had to cope with a severe shortage of tetraethyl lead and alkylate for aviation fuel, an inadequacy of heating oils on the East Coast, the loss in Iran of a sizable segment of the world's oil supply and a host of other problems.

PAD's problems differed from those of PAW only in degree. The war which made it necessary was localized but our military forces were almost as widely scattered as they were during World War II.

Like its predecessor, PAD called on the industry for the best men it could supply to deal with the situation. It was fortunate in getting Bruce K. Brown, a veteran assistant deputy administrator of PAW, as its first head. J. Ed Warren took over when Brown returned to his post as president of Pan-Am Southern Corp., and Joseph A. LaFortune, vice chairman of Warren Petroleum Corp., wound the show up.

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Gas Price at Issue

Congress never lacks an issue involving natural gas. This time it's prices.

In a rate case soon to be decided by the Federal Power Commission, Panhandle Eastern Pipe Line Co. contends it is entitled to the fair commodity value of gas it produces from its own holdings in Texas, Kansas, and Oklahoma. The company maintains five justices of the Supreme Court have declared this to be proper and reasonable under the Natural Gas Act.

The FPC in Democratic administrations established a policy that natural-gas transmission companies were entitled to only a "fair return on the actual cost" of reserves they own and produce. Apparently fearing the presently Republican-dominated FPC will reverse that policy, Sen. Homer Ferguson of Michigan has introduced a bill to amend the law to provide specifically that the value of such gas "shall in no case be deemed to exceed the actual original cost of such reserves."

Panhandle argues that policy allows its investors a return of less than nothing for gas it produces and has the stifling effect of discouraging exploration for new supplies and curtailing production—all to the detriment of the gas consumer.

Ferguson argued before the Senate that any changes would mean "literally billions of dollars" of additional profits to company shareholders and that consumers would pay more billions in higher rates.

ministrator in charge of foreign operations of the Petroleum Administration for Defense.

The study will determine the success of the United States-backed projects and will serve as a guide in conducting future economic development programs.

Refining Dividends Up

WASHINGTON. — Dividend payments by oil refining corporations during the 6 months ending in February increased $50,000,000 over the same period last year.

The Commerce Department said last week refiners' cash dividend payments for the period were $559,500,000 compared to $509,500,000 in the same 6 months of 1953. February payments were $8,000,000 compared to $3,300,000 last year.

ROCKY MOUNTAIN

New Line Planned

Oil Basin plans products pipeline to east Montana

BILLINGS, Mont.—Plans for a 230-mile, 8-in. products line from Laurel, Mont., through Billings to Glendive, near the North Dakota State line, have been announced by Oil Basin Pipeline Co.

William H. Tegtmeyer, president, said construction will get under way as soon as weather permits and will be completed before the end of the summer. The line will have an initial capacity of 12,000 bbl. per day, which can be increased to 20,000 bbl. by addition of a pumping station.

Tegtmeyer said Carter Oil Co., which has a 25,000-bbl. refinery at Billings, and Farmers Union Central Exchange, with a 15,000-bbl. refinery at Laurel, have agreed to use the line.

The line, to cost $5,350,000, will be the first products line into the Glendive area.

Tegtmeyer said private financing for the project is being arranged by William H. Tegtmeyer & Co., an investment firm.

The potential products market in the eastern Montana and western North and South Dakota area attracted other pipeline groups, with Williston Basin Pipe Line, Inc., last fall negotiating for construction of a 250-mile, 8-in. line from the Billings area to Glendive *(The Oil and Gas Journal, November 2, page 161)*.

The proposed $7,000,000 line was to have been financed by Dillon, Reed & Co., New York investment brokers. Williston Basin had received a certificate of necessity for the project.

Field Proration Requested

DENVER.—Colorado Oil and Conservation Commission is expected to rule within 30 days on a request for production restrictions on wells in the Little Beaver field of northeastern Colorado.

Frank Zimmerman, reservoir engineer for Lion Oil Co., made a proposal to limit production from 66 D sand wells to 100 bbl. a day and restrict J sand wells to 150 bbl. a day. No objections to his suggestion were raised by 60 oil men present.

Harry Trueblood, Goodall Oil Co., told the commission the D sands contain between 36 and 44 million barrels of oil but only 25 to 28 per cent will be recovered unless conservation practices are adopted.

Colorado Oil Play Shifts

DURANGO, Colo.—Current exploratory interest in Colorado has shifted to the Paradox basin in the southwestern part of the state.

The increased interest is a result of an important strike by Three States Natural Gas Co. in Dove Creek field, Montezuma County. The 2 White reported a flow of 142 bbl. of 48°-gravity oil per day on drill-stem test.

The discovery well in Dove Creek field, the 1 White, was drilled by Western Natural Gas Co. et al in 1948. It tested for a flow of 20 bbl. of 69°-gravity oil hourly with 5,000 M.c.f. of gas per day. Four subsequent wells in the field were suspended at various depths. The field has been quiet since that time until the recent development program by Three States. The area has no nearby market outlet.

Across the state line in Utah, Three States recently discovered oil from the Hermosa (Pennsylvanian) in San Juan County's Bluff Unit. This well is the first indicated commercial producer in the southeastern Utah portion of the Paradox basin. The discovery well is shut-in after swabbing 30 bbl. of oil per day.

Now It's Official!

BUFFALO, S. D.—South Dakota is now the nation's twenty-eighth oil state —officially.

Shell Oil Co., which first found oil production late last year in its 1 State "A" in Harding County, has completed the well to officially open the first oil pool in the state.

The discovery well pumped 80 bbl. of 31°-gravity oil per day from two zones in the Red River (Ordovician). The discovery is 30 miles southeast of Little Beaver field, in Montana's Fallon County. Location is in SW SE 9-21n-4e in the extreme northwestern part of the state.

Nevada Governor Inspects State's First Discovery

Nevada Gov. Charles H. Russell, along with a Shell Oil Co. vice president and members of the Nevada State Oil and Gas Conservation Commission, are pictured paying a visit to an apparent oil discovery which might become the state's first commercial producer. Governor Russell, right foreground, chats with W. C. Thompson, left foreground, Shell's drilling foreman, on the 1 Unit, SE NE NW 35-9n-57e, in the Eagle Springs area near Ely in Nye County. Behind Governor Russell is S. F. Bowlby, Shell vice president.

30,000-cu. ft. of Storage Space

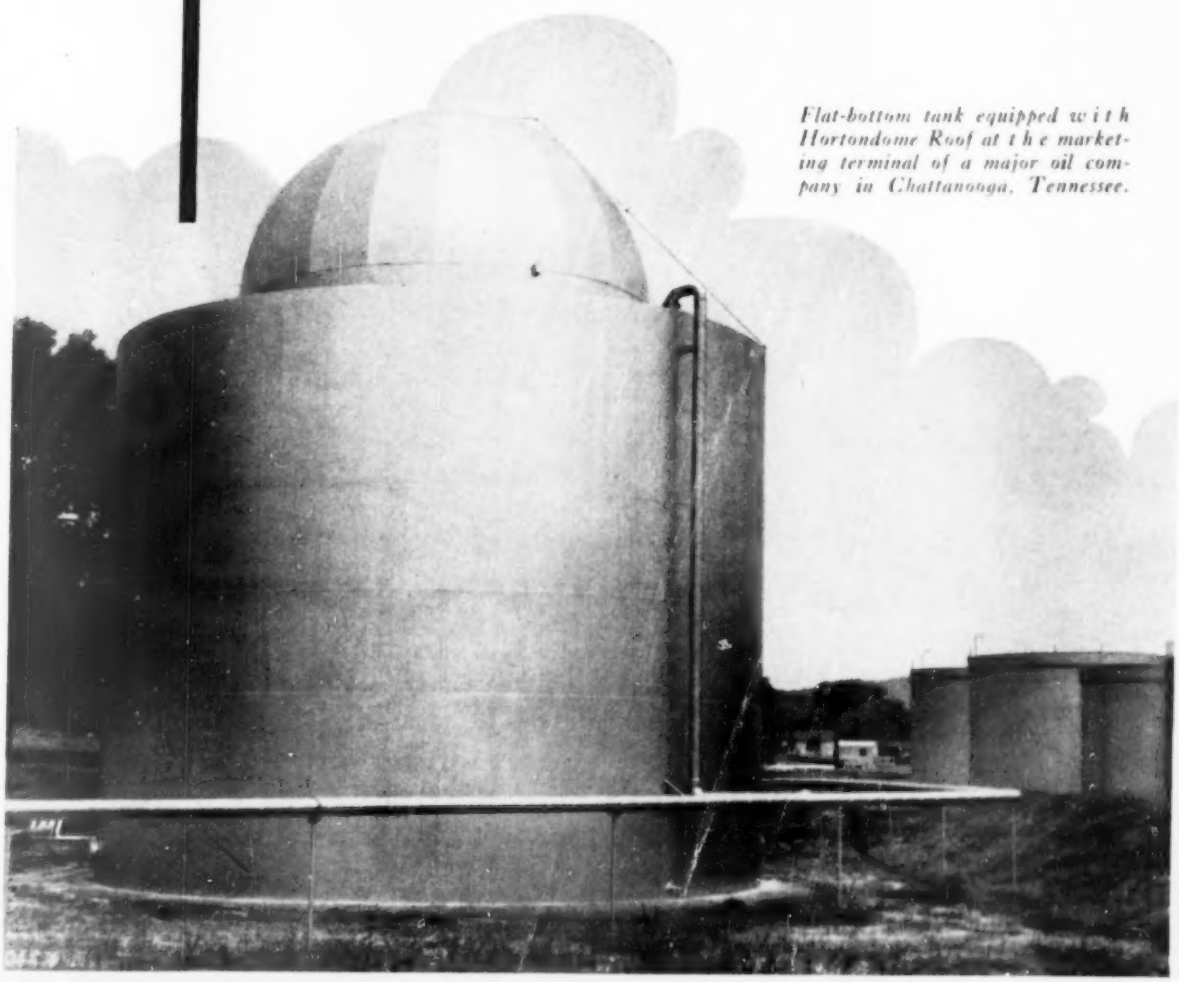
to prevent evaporation losses from standing storage tanks

This 30,000-cu. ft. Hortondome* Roof was installed on a 24,000-bbl. tank for a major oil company at Chattanooga, Tennessee. A flexible, hemispherical membrane, attached by its outer edge to the equator of the Hortondome, moves up and down as air-vapor mixture in the tank expands or contracts. No vapor is vented to the atmosphere unless expansion exceeds the capacity of the installation.

A tank with a Hortondome Roof may be operated as an individual unit or it may be connected, by vapor lines, to the vapor spaces of one or more adjacent tanks with fixed roofs. The Hortondome Roof shown in the photograph below is interconnected with two 24,000-bbl. cone roof tanks.

Further information, estimates or quotations on the Hortondome Roof, or any other Horton structure, may be obtained by writing our nearest office.

*Trade Mark



Flat-bottom tank equipped with Hortondome Roof at the marketing terminal of a major oil company in Chattanooga, Tennessee.

CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

Atlanta, 3 ..... 2154 Healey Bldg.
Birmingham, 1 ..... 1536 North 50th St.
Boston, 10 ..... 1025-201 Devonshire St.
Chicago, 4 ..... 2128 McCormick Bldg.
Cleveland, 15 ..... 2204 Midland Bldg.
Detroit, 26 ..... 1514 Lafayette Bldg.
Houston, 2 ..... 2119 C & I Life Bldg.
Los Angeles, 17 ..... 1523 General Petroleum Bldg.
New York, 6 ..... 3347—165 Broadway Bldg.
Philadelphia, 3 ..... 1615—1700 Walnut Street Bldg.
Pittsburgh, 19 ..... 3228 Alcoa Bldg.
Salt Lake City, 4 ..... 525 West 17th South St.
San Francisco, 4 ..... 1554—200 Bush St.
Seattle, 1 ..... 1325 Henry Bldg.
Tulsa, 3 ..... 1606 Hunt Bldg.

REPRESENTATIVES AND LICENSEES

Horton Steel Works Limited, Fort Erie, Ontario, Canada
Ateliers et Chantiers de la Seine Maritime, Paris, France
Constructions Metalliques de Provence, Arles-sur-Rhone, France
Chicago Bridge & Iron Company, Ltd., Apartado 1348, Caracas, Venezuela
Comprimo, N. V., 21, Amstel, Amsterdam (C) Netherlands
Compagnia Tecnica Industrie Petroli, Rome, Italy
Whessoe Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Sociedade Chibridge de Construcoes Ltda., Av. General Justo, 275, Grupo 306, Rio de Janeiro, Brazil

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You can ask your Nalco Representative questions and get straightforward answers . . . And if you stump him, he—and you—can put the whole Nalco Laboratories' and Service staffs to work on a plain-language plan of action to get you better water treatment results, most economically.

If you are not already getting the security from water treatment troubles that regular calls from your Nalco Representative bring, call or write today for prompt action.

Nalco WATER TECHS

A paper on "A Laboratory Method for the Study of Steam Condensate Corrosion Inhibitors," presented at the 8th Annual Conference, National Association of Corrosion Engineers, has been reprinted by Nalco for distribution to men interested in this problem. Your copy will be sent free upon request.

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World Output Dips

Kuwait cutback principal cause of 0.6 per cent decline in January; Saudi Arabia sets new production record

Dahl M. Duff

FREE World production of crude oil in January dropped back slightly from the near-record level attained in December.

The average from non-Communist fields of the world amounted to 11,885,100 bbl. daily, down 67,000 bbl. daily, or 0.6 per cent, from the previous month.

The decline was principally due to a sharp cutback in Kuwait. This Persian Gulf shaikhdom, whose production last year made up nearly 7½ per cent of total Free World supply, averaged 795,000 bbl. daily, 155,500 bbl. daily less than the previous month.

Most of the other major world producing areas showed either gains or only small decreases. United States output was little changed from December, with the 6,240,400 bbl. daily average in January representing only a 2,400-bbl. increase over December.

The net change in foreign production was down 69,400 bbl. daily. Some of the decline in Kuwait was offset by an increase in Saudi Arabia of 74,800 bbl. daily to 934,700 bbl. daily, a new record. The previous high in this country was last July when output averaged 909,700 bbl. daily.

In the opening month of this year, total Free World production was 2.0 per cent higher than in January 1953. United States production in January was 314,900 bbl. daily, or 4.8 per cent, under the corresponding month last year, while total non-Communist foreign output was 551,800 bbl. daily, or 10.8 per cent, higher. The gain in the Middle East in the same period also was 10.8 per cent.

Middle East off . . . As a result of the sharp decline in Kuwait, total production in the Middle East in January was off 49,000 bbl. daily from the record high total of 2,540,000 bbl. daily established in December. January output from this region was only 65,200 bbl. daily above the 2,426,000 bbl. daily average for all of 1953.

Production in the larger individual countries of the Middle East, however, often shows sharp month-to-month fluctuations and is of little value in establishing the longer trend. Gulf Oil Corp., in its official report on Kuwait production in January, said tanker dispersion was the principal cause for the month's drop in crude-oil liftings.

Iraq's production in January was down slightly from December.

Of this month's total, the revised production for Kirkuk field showed an average of 483,600 bbl. daily, 25,700 bbl. daily for Ain Zalah and Butmah, and 67,600 bbl. daily for Zubair. Production in Qatar in January was back to its more normal level of near 100,000 bbl. daily. The National Iranian Oil Co. in January reported a gross production for January of 61,200 bbl. daily of which 28,200 bbl. daily were recycled, leaving a net of 33,000 bbl. daily.

New producer . . . The Kuwait-Saudi Arabian Neutral Zone entered the list of producing countries for the first

TREND OVER THE LAST YEAR

1953—	Western Hemisphere less U.S.	Middle East	Total Non-Communist Foreign
February	2,407.2	2,258.4	5,096.8
March	2,412.5	2,266.1	5,104.8
April	2,448.1	2,426.8	5,306.6
May	2,423.1	2,523.7	5,391.0
June	2,459.4	2,536.0	5,450.1
July	2,487.7	2,534.0	5,471.9
August	2,443.3	2,489.0	5,387.3
September	2,485.7	2,416.4	5,345.3
October	2,519.5	2,528.1	5,511.5
November	2,651.9	2,341.7	5,461.6
December	2,711.9	2,540.2	5,714.1
1954—			
January	2,691.4	2,491.2	5,644.7

CRUDE-OIL PRODUCTION

(Daily average in thousands of barrels)

Country—	1954	1953	1953
Hemisphere: Western	Jan.	Dec.	Jan.
Argentina	80.3	83.6	69.5
Bolivia	3.0	2.9	1.3
Brazil	2.2	2.1	2.3
Canada	268.0	260.7	170.5
Chile	4.5	4.7	2.9
Colombia	113.4	106.2	107.0
Cuba	0.1	0.1	0.1
Ecuador	8.2	8.5	8.1
Mexico	196.0	206.0	208.0
Peru	44.5	39.9	44.1
Trinidad	61.8	62.0	60.0
Venezuela	1,909.4	1,935.2	1,744.6
Total	2,691.4	2,711.9	2,418.4
Europe and Africa—			
Algeria	1.7	1.6	1.3
France	7.4	7.3	6.7
French Morocco	2.2	2.2	1.8
W. Germany	46.0	45.0	37.4
Italy	1.6	1.7	1.9
Netherlands	17.1	16.7	13.1
Egypt	37.5	37.3	46.0
United Kingdom	1.0	1.0	1.1
Total	114.5	112.8	109.3
Middle East—			
Bahrain	29.9	30.2	30.1
Iran	33.0	19.5	18.4
Iraq	586.9	592.8	533.2
Kuwait	795.6	951.1	806.6
Neutral Zone	14.3		
Qatar	96.1	86.3	78.0
Saudi Arabia	934.7	859.9	780.9
Turkey	0.7	0.4	0.5
Total	2,491.2	2,540.2	2,247.7

Country—	1954	1953	1953
Other Asia	Jan.	Dec.	Jan.
British Borneo	102.0	102.4	102.7
Burma	3.4	3.4	2.5
India	6.8	6.8	6.0
Indonesia	220.0	221.2	191.4
Japan	6.0	5.9	5.7
New Guinea	4.7	4.8	4.8
Pakistan	4.7	4.7	4.4
Total	347.6	349.2	317.5
Total, Non-Communist, foreign	5,644.7	5,714.1	5,092.9
United States	6,240.4	6,238.0	6,555.3
Total Free World	11,885.1	11,952.1	11,648.2
Est. Russia & Eastern Europe—			
Russian Occupation Zone of Austria	62.0	62.0	60.0
Romania	110.0	110.0	85.0
Russia	1,085.0	1,085.0	1,010.0
Other Communist	31.9	31.9	25.1
Total	1,288.9	1,288.9	1,180.1
World total	13,174.0	13,241.0	12,828.3

Figures are from reliable reports in the industry or official government sources. Data for Russia and Eastern Europe are based on competent estimates; no authentic information is available on month-to-month production in these regions. Estimates also have been made for certain other countries, particularly in Southeast Asia, for which completely current reports are lacking. Iranian production shown is not output, not including recycled material. Other Communist includes China and Yugoslavia as well as the Soviet satellite countries in Europe.

time in January. American Independent Oil Co., the operator for itself and Pacific Western Oil Co., reported a total in January of 442,049 bbl., from five wells, for an average of 14,300 bbl. daily. Actual production began late in December, but during that month, output was restricted due to limitations imposed by testing and bringing into operation the shipping and handling facilities.

Commercial production in the Neutral Zone brought the list of Middle East oil countries to eight, including Turkey. Turkish production continues to be of a minor nature pending completion of a new refinery.

In Europe, another slight increase brought West German production to the latest in the succession of records which have characterized operations in this country the last 5 years.

Egyptian production was down some 8,000 bbl. daily from the 45,000-46,000 bbl. daily level of the last several years. The decrease was in Asl, one of the two Sinai fields. Company officials have warned of a drop in output from this area. The Sinai fields have a water drive with extremely porous formations.

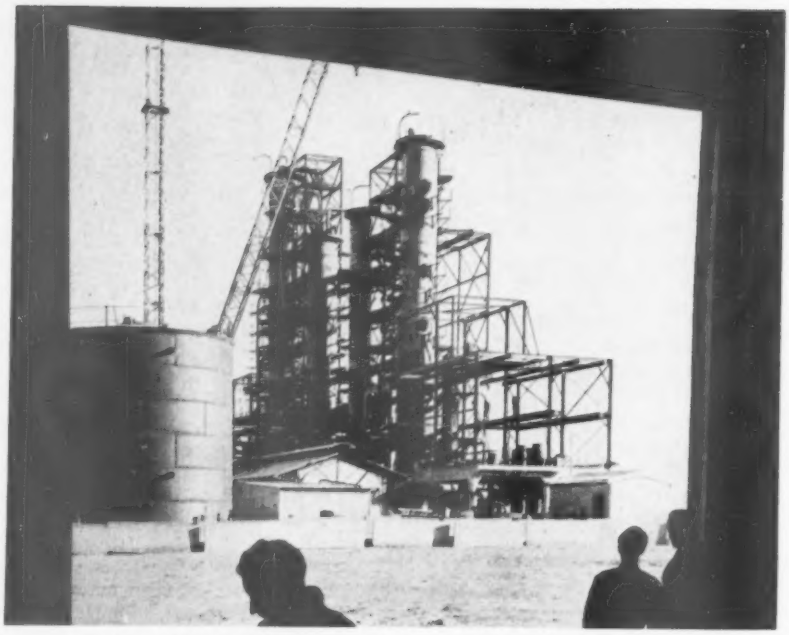
In Indonesia, production continued at a relatively high level. The increased output over the last year and a half has been largely due to the Caltex field in central Sumatra. Caltex production from Minas field in January accounted for 42,600 bbl. daily of the Indonesian total. The remainder was produced by Shell and Standard-Vacuum.

Recent announcements of the Communist governments in Eastern Europe occasioned revisions in current production estimates. Czechoslovakia is now believed to have an output of about 2,500 bbl. daily, while Albanian production is running slightly above 3,100 bbl. daily. Another 14,000 bbl. daily is attributed to Hungary.

Drop in Venezuela . . . Venezuelan production in January was down from the record high level set during the previous month. The January average of 1,909,400 bbl. daily represented a drop of 25,800 bbl. daily.

However, Venezuela's January output was 170,200 bbl. above the average for all of 1953. Last year, Venezuelan production was depressed because of a slump in heavy fuel-oil markets and continued loss of European outlets to Middle East production. Venezuela was the only major oil country showing an actual decline in production last year.

In Colombia, production averaged 113,388 bbl. daily in January. This was slightly above the previous record high for the country in March 1953.



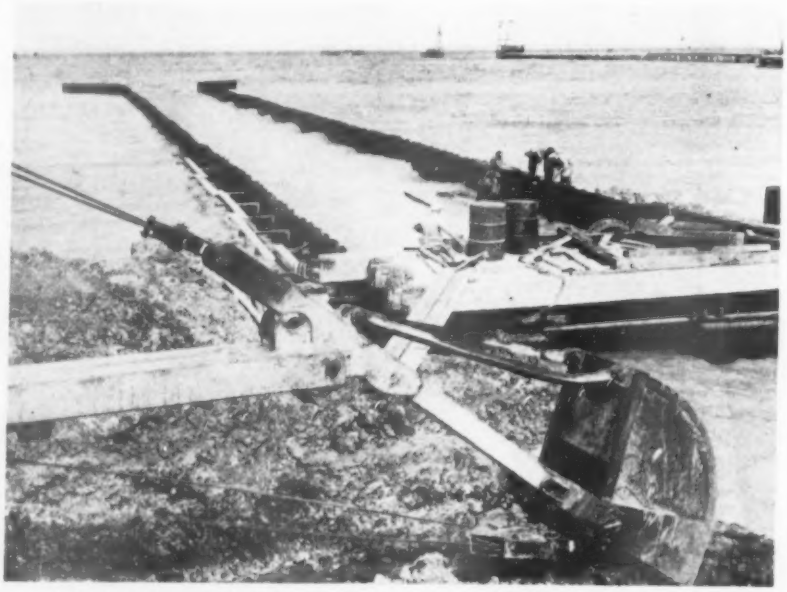
DISTILLATION UNIT at the new Shell refinery at Geelong (Shell photo).

New Refinery on Stream

Shell's Geelong refinery, first of four major Australian projects, goes on stream 40 miles southwest of Melbourne

A NEW 28,000-bbl.-daily refinery was placed in operation recently by the Royal Dutch-Shell Group at Geelong, 40 miles southwest of Melbourne in Australia.

The opening ceremony was performed by Field-Marshal Sir William Slim, the governor-general of Australia. The refinery is the first to be completed of four major refining projects



SALT-WATER INTAKE for the Geelong refinery cooling system (Shell photo).

now under way in Australia. These will raise the commonwealth's refining capacity by 140,000 bbl. daily.

The start of operations at the refinery marks the completion of the first stage of construction. The second stage includes construction of a fluid catalytic cracking unit of about 13,000 bbl. daily capacity. This unit is scheduled for completion by the middle of next year. A polymerization plant also is planned.

Total cost of the present facilities at the refinery is the equivalent of slightly more than $20,000,000, and the cracking unit will more than double the investment in the project.

The refinery is located on a 250-acre site connected to Melbourne by a recently completed 36-mile, 8-in. pipeline. Throughput of the line amounts to about 17,500 bbl. daily, and this could be raised to around 47,000 bbl. daily by the construction of an auxiliary pumping station. The line will move both motor fuel and diesel fuel.

The Geelong Harbour Trust is dredging the port approaches to a depth of 32 ft. and building an oil jetty capable of accommodating tankers of up to 18,000 d.w. tons. The refinery will charge crude oil from Seria field in British Borneo and from the Middle East.

Veracruz, and at Moales and Vernet in Tabasco.

Exports slump . . . Because of a slump in export demand, crude production dropped to 74,097,213 bbl. as compared to 78,906,527 bbl. the previous year. Mexican consumption in 1953 amounted to 55,480,786 bbl., an increase of slightly more than 5,000,000 bbl. Exports dropped by a half a million barrels to 15,348,093 bbl. No figures were given on Mexico's oil imports.

Mexican refining capacity now amounts to 272,000 bbl. daily, and several projects are planned to raise this substantially in the future. About 320 miles of pipelines were laid in 1953, as compared to 155 miles in 1952 and 193 miles in 1951.

French Group Seeks Venezuela Concession

REPRESENTATIVES of a new French oil group are in Caracas seeking concessions which would allow it to enter the Venezuelan industry.

Michel Homolle, who retired in December as managing director of the Suez Canal Co. and who is now a member of its board, said in Caracas last week most of the capital subscribed in France for the Venezuelan undertaking had been advanced by the Suez Canal Co.

He said a $1,000,000 fund was available for preliminary work and indicated the group was ready to bid for concession acreage in Barinas. Any oil production developed, he said, would be used exclusively in France.

Recent indications are that the Venezuelan Government may now be about ready to grant the first new oil concessions in the country since 1944. The existing operating companies, as well as several large American companies not now holding Venezuelan acreage, are prepared to make offers to the government. The Barinas region, where there is considerable open acreage near the Socony-Vacuum and Sinclair discoveries, is a region of prime interest.

The Suez Canal Co.'s shipping representative in New York said he had no information on the oil venture, but declared that the Suez company as such was not entering the South American oil business. He pointed out that the company has substantial funds available, and the step is undoubtedly a part of its investment program.

Mexico Totals Score

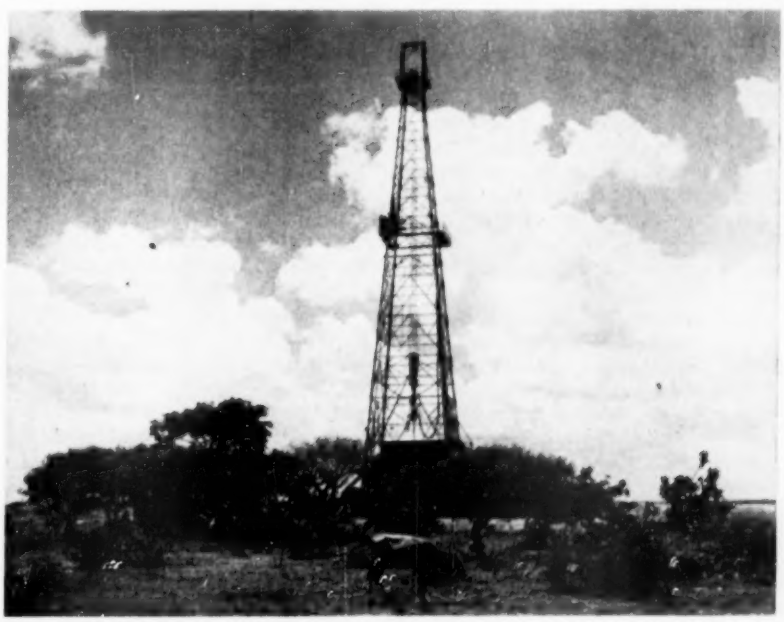
Expropriation anniversary prompts review of industry

MEXICO'S reserves of liquid petroleum now amount to 1,642,000,000 bbl., and in addition the country has another 655,000,000 bbl. represented in the calorific value of its natural-gas reserves.

These and other figures on the status of the Mexican oil industry were given by Sen. Antonio J. Bermudez, director-general of Petroleos Mexicanos, in a report to the government on the sixteenth anniversary of the Mexican oil expropriation.

During 1953, drilling was increased by 16 per cent, and 355 wells were completed, as compared to 307 in 1952. During 1953, a total of 14 new-field discoveries were made—Chapul, 18 de Marzo, and Rio Gravo, all in Tamaulipas; Zacate in Nuevo Leon; Mozutla, Santa Agueda, Ocotepec, Xacotla, Miguel Hidalgo, Cabo Rojo, Angostura, Ostapa, and Los Soldados, all in Veracruz; and Cantemoc in Tabasco.

Angostura was named as the year's outstanding discovery. In addition, during the first quarter of 1954, three discoveries were made, at Casa Blanca in



Rigs Still Active in Eastern Venezuela

Operations such as this have met with considerable success in developing additional light oil in Eastern Venezuela during the last year. This Socony-Vacuum Oil Co. of Venezuela rig is working in the State of Anzoategui where the company found its first production almost 20 years ago. Today it is the fourth leading Venezuelan producer with an output of about 65,000 bbl. daily. As of early February, 67 rigs were active in Eastern Venezuela in contrast to 31 in the western region. In addition, 20 strings were employed on workovers, two on cleanouts, and one on repairs throughout the country. (Socony-Vacuum photo).

French Discovery

Esso Standard well on only French foreign concession

AN oil discovery has been made by Esso Standard, S. A. F., in the second well drilled on its concession in southwestern France.

The company's Parentis test about 44 miles southwest of Bordeaux recovered 1,000 ft. of gas-cut oil with a little mud and no water on a short drill-stem test from 2,255-2,264 m., or around 7,400 ft. Earlier, bleeding limestone cores were taken in the zone where circulation was lost.

Further tests of the well were planned. The crude appeared to be nonsulfurous; the gravity was not available. The formation tested apparently was the Lower Cretaceous, the same as that which is productive in the French-operated Lacq field about 80 miles southeast in the foothills of the Pyrenees.

The Parentis structure was a geophysical prospect outlined by seismograph following gravity, magnetometer, and some telluric-current reconnaissance work. The well is being drilled by the French contractor, Forex, using largely American equipment.

Last year, Esso Standard drilled its first well, Mano 1, about 18 miles northeast of the Parentis location. This test was bottomed dry in the Lias of the Lower Jurassic at 9,014 ft.

Only foreign company . . . Esso Standard is the only foreign company participating in the extensive exploration for oil which has been carried out in metropolitan France since shortly after the end of the war. Elsewhere, the work has been through government-financed French companies.

Approximately 60 per cent interest in Esso Standard is held by Standard Oil Co. (N. J.) and another 10 per cent by Gulf through United Petroleum Securities Corp. Atlantic Refining Co. formerly held a small interest in the company but sold this last year, reportedly to the Jersey company. Other stock is publicly owned in France.

Jersey Standard did reconnaissance geology in parts of southwestern France in 1939. The present concession—the only one held in France by a non-French firm—was approved in February 1952 and covers 4,300,000 acres roughly centered on Bordeaux. The initial exploratory period was for 5 years with extensions possible. Terms of the concession provide that when production is found, a producing company will be organized in which the French Government will hold 10 per cent interest.

The only major production developed as a result of the French exploratory program has been the 1949 Lacq discovery of Soc. Nationale des Petroles d'Aquitaine. This field now has an output of about 6,000 bbl. daily, and the company is attempting to develop production from deeper formations at about 12,500 ft.

German Producer Flows

Schmedenstedt 2, an exploratory well drilled by Deutsche Vacuum Oel, A.G., near Peine in West Germany, has been tested as a flowing producer from the Dogger Beta sands at about 2,830 ft.

The well was located on the northeast flank of the Oberg structure. The crude is light and similar to that in Oberg field.

Earlier, Wintershall, A.G., made an oil discovery in its Bockstedt 2 wildcat about 20 miles southwest of Bremen and 1.8 miles north of Aldorf field. The well tested 13 bbl. an hour through a 9/32-in. choke from the Valendis of the Lower Cretaceous at 3,878-3,907 ft.

Further production tests have shown a relatively small gasoline content in gas produced from the Bavarian wildcat, Ampfing 2. The well has been shut in, and offsets are planned to determine if the discovery is commercial. The well represents the joint interest, Deutsche Vacuum Oel - Gewerkschaft Elwerath-Preussag.

Creole Spending to Rise

NEW YORK. — Creole Petroleum Corp. will spend more money for plant and equipment during 1954 than during 1953 or 1952, when yearly capital expenditures climbed near $100,000,000.

In the company's annual report, A. T. Proudfit, president, said the 1953 spending was $94,440,175 and the 1952 total $96,391,960. He said present indications are that the 1954 capital expenditures program "will be somewhat higher."

Proudfit also expressed hope that the Venezuelan Government will grant new oil concessions in the near future. He said Venezuela is the only major oil country that produced less oil in 1953 than in 1952.

"If Venezuela is to obtain its share of the long-term growth in the world oil demand, new concessions are required," Proudfit said. "The company has made known its views to the Venezuelan Government in this respect."

International Briefs

Peruvian Pacific Petroleum Co. (Cities Service and Richfield) has spudded its first test on acreage held in the northeastern Peruvian coastal section under contract with the government Empresa Petrolera Fiscal. The well is 15 miles from the coast and about 2½ miles from the nearest production in the Lobitos concession. It is being drilled by Santa Fe Drilling Co., and at last report, was at about 4,000 ft. In the Sechura, International Petroleum Co., Ltd., was reported moving a rig to a new block just north of Piura for a second wildcat on a Seaoil block in which International has 50 per cent interest. Richmond Oil Co. has abandoned its Inca 5 test in the southern Sechura at 5,994 ft. and is preparing to move the rig about 25 miles north to Belisario for a new test.

American International Fuel & Petroleum Co. (Gulf) is moving in tanks and other production equipment for thorough testing of a wildcat discovery made several months ago near Ragusa, Sicily. When drilled, the well found production in formations topped at 6,200 ft., and reported shows for several hundred barrels daily of about 20°-gravity crude. A second well is being drilled about 0.6 mile south of the discovery and was recently reported at about 900 ft. and having some difficulty with lost circulation.

Consumption of major petroleum products last year in Colombia averaged 29,006 bbl. daily, a gain of 25.5 per cent over 1952. Sharpest increase among major individual products was in kerosine, up 42.7 per cent to 35,099,950 gal. Consumption of other products and the change from 1952 was: aviation gasoline, 18,370,646 gal., up 9.7 per cent; gasoline, 204,078,056 gal., up 24.0 per cent; tractor fuel, 8,151,426 gal., down 9.6 per cent; diesel oil, 53,964,557 gal., up 30.3 per cent; and fuel oil, 125,918,006 gal., up 28.8 per cent.

Sayid Mohammed Abdul Ghani el-Naqib, director general of oil affairs in the Iraq Ministry of Economics, has been appointed as the government's second director on the boards of Iraq Petroleum Co., Ltd., and the associated Basrah Petroleum Co., Ltd., and Mosul Petroleum Co., Ltd. At one time government oil inspector at Kirkuk, he was educated at the American University of Beirut and at Birmingham University in England. The Iraq Government has had one representative on the board of I.P.C. for the last 25 years.

C. F. Dohm Advanced

Globe-trotting executive named Conorada president

FRIENDS of C. F. Dohm never know from one week to the next whether he will turn up in Turkey, East Africa, Peru, or some other far-away country of potential oil interest.

For the last 4 years he has been vice president and exploration manager of Conorada Petroleum Corp., the foreign exploration and concession-finding subsidiary of Continental Oil Co., Ohio Oil Co. and Amerada Petroleum Corp.

Full direction of the activities of this company was turned over to Dohm when he recently was elected president, becoming at the same time a member of the Conorada board.

Dohm—who is called "Butch" by his friends—is a native of Louisiana who has spent the last 17 years in foreign work. He is a geologist by education and training, but now finds himself concerned as well with the legal, economic, and political aspects in possible operating areas abroad.

Worked in dust bowl . . . He grew up in the small sawmill town of Bogalusa, La., and in 1934 received a bachelor of science degree in geology from Louisiana State University in Baton Rouge. After a summer with the Louisiana Soil Conservation, he returned to the university with a research fellowship from the Mississippi River Authority.

He completed most of his Ph.D. requirements, but lack of money forced him to discontinue after obtaining a master's degree in geology in 1936. The following year he did research in climatology and physiography in the dust bowl of western Oklahoma and then was transferred to the Soil Conservation Service's Washington office.

The idea of travel and working in the open led him into the petroleum industry in 1937 when he joined Standard Oil Co. of Venezuela. After 2 years doing mostly surface mapping in Eastern Venezuela for this Creole affiliate, he was transferred to the Island of Hispanola. He spent 3½ years doing geological work in various parts of that island.

Made chief Jersey geologist . . . In early 1943, when Standard Oil Co. (N. J.) decided to initiate an exploration program in Cuba, Dohm was sent there to start that venture. Two years later he was given the job of directing, from Cuba, Jersey Standard's exploratory activities throughout Central America and the Caribbean.

After about a year in this position, he joined Tropical Oil Co. as its chief geologist. In 1947 when Walter Link was made chief geologist for Jersey Standard in New York, Dohm succeeded him as exploration manager of Tropical.

His interests in foreign oil operations became virtually world-wide when he joined Conorada in 1949. In what free time these duties leave, he follows an avocation of cattle ranching and a hobby of model railroading. He's still an aviation enthusiast, having learned to fly when he was in his teens. He and Mrs. Dohm and their three children have an apartment in suburban Hartsdale, north of New York.

William Marlowe has been elected president of Mid-Island Petroleum Co., Springfield, Ill. Other officers named are **Fred Brown, Sr.,** vice president; **Harry Armstrong,** secretary-treasurer; and **Roscoe Bonjean, Norman Cadigan, Henry Alexander, William Glen Durham,** and **W. O. Withrow,** directors.

Harry Dereniuk has been promoted by Deep Rock Oil Corp., from chief primary to assistant chief engineer in the exploration and production division. Among his new duties will be the engineering supervision of Deep Rock's secondary-recovery projects. He also will supervise the company's evaluation personnel. Dereniuk, with Deep Rock since 1950, will remain in the firm's general offices in Tulsa.

E. N. Van Duzee, on special assignment in Shell Oil Co.'s New York office the past year, has returned to New Orleans as area production manager. **J. W. Pittman,** who has been production manager during Van Duzee's absence, is now on special assignment in New York.

Harold G. Owen, formerly process engineer at Continental Oil Co.'s refinery at Billings, Mont., has been appointed staff engineer of the firm's petrochemicals division in Houston. Before going to Montana, Owen was technologist for Continental's Rocky Mountain region in Denver.

T. R. Barnes has been advanced from division exploration manager for Shell Oil Co. at Billings, Mont., to senior

T. R. BARNES

H. L. THOMSEN

geologist in the firm's newly organized Denver area office. **H. L. Thomsen** has succeeded Barnes, who will remain in Billings for the present working on problems involving Shell's exploration and development program in the Williston basin. Barnes has been with Shell 19 years and at Billings since 1949. He served as district geologist there until November 1953 when he was made division exploration manager. Thomsen joined Shell in 1935 and was division geophysicist in Denver before being transferred to Tulsa as area geologist. He has been on a special assignment for the past year.

A. A. Curtice, former president of Conorada Petroleum Corp., is opening an office in New York as a petroleum consultant specializing in negotiations and operations outside the United States. Before becoming president of Conorada in 1949, Curtice was a partner in the exploration firm, Hoover, Curtice & Ruby. He was an adviser to the Venezuelan Government in prepa-

PERSONALS

ration of its 1943 petroleum law and has assisted other foreign governments in connection with petroleum-industry policy. Prior to 1941, he was a consultant for more than 20 years with headquarters on the West Coast.

W. A. M. Greeven has been elected to the board of directors of Creole Petroleum Corp., an affiliate of Standard Oil Co. (N. J.) operating in Venezuela. Prior to joining Creole on April 1, he was representative in Lisbon, Portugal, of Standard Oil Co. (N. J.) for Portugal, Spain, and northwestern Africa.

A. F. (Gus) Beck has resigned from Imperial Oil, Ltd., to join Canadian Export Gas, Ltd., an independent gas company being formed in Calgary, Alta., as vice president and general manager. Beck has been with Imperial Oil for the past 10 years and established the company's district office in Regina, Sask., in 1950. He was later moved to Calgary as assistant exploration manager in the Alberta division. He returned to Regina last December as producing coordinator for Imperial in the Regina district which includes Saskatchewan and Manitoba.

Bill C. O'Donnell, research geologist for Midstates Oil Corp., has resigned to open consulting offices in Tulsa. For the past 7 years he has been in the firm's district offices at Wichita, Kans., and Tulsa.

N. H. Potts has been advanced from assistant regional manager to manager in Oklahoma City for William Ross Cabeen & Associates. He replaces **Tom Fee,** who has opened offices in Oklahoma City as a consulting geologist.

Allan Dexter Graves, formerly with Socony Vacuum Exploration in Canada, has been appointed manager for the company's activities in Colombia, succeeding the late Homer J. Smith.

W. O. LINDSEY

W. O. Lindsey has been elected vice president and a director of F. E. Shaw, Ltd., pipeline engineering and construction company headquartered in Sarnia, Ont. Lindsey was manager of labor relations for Williams Brothers Co., Tulsa. He also was assistant to **B. E. Hull** during construction of both the "Big Inch" and Trans Arabian pipeline systems.

W. P. GEE

A. W. BAUCUM

William P. Gee, formerly assistant to the president of The Texas Co., has been placed in charge of all the company's petrochemical activities. He also will be responsible for the firm's activities in the field of synthetic rubber. **A. W. Baucum,** assistant to the vice president in charge of the producing department since 1950, has replaced Gee as assistant to the president. **Dr. Paul S. Stutsman,** supervisor of chemicals research at Texaco's principal research laboratories at Beacon, N. Y., has been transferred to Gee's office to assist in over-all company activities relating to development and production of petrochemicals.

Peter C. Henry, assistant area production superintendent for Gulf Refining Co., has been transferred from Pierce Junction, Tex., to Cut Off, La.

F. M. Graves has been promoted from chief process engineer to assistant director of Magnolia Petroleum Co.'s refinery technical department at Beaumont, Tex. He succeeds **Courtenay Marshall,** who has entered private business.

Robert Knebel, formerly geologist at Dallas for Lone Star Producing Co., has been named geologist in charge of the firm's newly opened regional office in San Antonio. The company's geological and production activities in South Texas will be directed from the new office.

R. G. (Rusty) Cunningham has been appointed general superintendent in charge of drilling operations by Mesa Drilling Co., Denver. He formerly was with C. G. Glasscock Drilling Co., Corpus Christi, Tex.

Walter H. Walne, Jr., has been elected a vice president of Felmont Oil Corp., Midland, Tex. Walne joined American Maracaibo Co. organization, parent firm of Felmont, early last year as acting manager of exploration and later was made exploration manager.

Texas' Reserves Show Percentage Dip, Bass Says

Harry Bass, center, president of the Texas Mid-Continent Oil and Gas Association, talks with R. F. Windfohr, Fort Worth independent, and Perry Bass, Richardson & Bass, Fort Worth, after he addressed about 400 members of the Central and North-Central Texas region of the Texas Mid-Continent Oil and Gas Association at a recent meeting in Fort Worth. In his speech Bass emphasized that Texas is steadily slipping in its percentage of natural crude-oil and natural-gas reserves and said this should serve as a warning to public policy makers on matters affecting petroleum. Windfohr is former head of the Texas Mid-Continent group and now president of the Mid-Continent Oil and Gas Association. Perry Bass is North-Central district vice president of Texas Mid-Continent.

PERSONALS

Richard Brewer, formerly district seismic supervisor with Atlantic Refining Co. in Shreveport, has been named vice president and supervisor of Continental Geophysical Co., Fort Worth. Prior to joining Atlantic Refining, Brewer was employed with Shell Oil Co. in Louisiana, Texas, and New Mexico.

Leroy H. Hines, formerly vice president in charge of oil development for Northern Pacific Railway Co., and **J. B. Mitchell,** formerly assistant to the chief of the conservation division of the U. S. Geological Survey, have formed Hines & Mitchell, petroleum consulting firm, with offices in Washington and San Francisco.

R. G. ALLEN

Russel G. Allen has been elected executive vice president of Godfrey L. Cabot, Inc., Boston, replacing **Thomas D. Cabot,** who was recently elected president. Allen joined the Cabot organization in 1925 and has been a vice president since 1943. He is also an officer and director of several Cabot subsidiary companies.

P.E.S.A. Holds District Meeting in Los Angeles

Officers and speakers are shown here at the recent Pacific district meeting of the Petroleum Equipment Suppliers Association. Left to right are: J. L. Kellogg, K. L. Kellogg & Sons; Otto Hammer, Security Engineering Co. and chairman of the Pacific district; R. S. Durkee, Lane-Wells Co. and vice president of P.E.S.A.; D. D. Bovaird, Bovaird Supply Co., Tulsa, and P.E.S.A. president; and R. H. Green, vice president in charge of production, Signal Oil & Gas Co.

Byron L. Plumley, petroleum engineer for Sinclair Oil & Gas Co., has been transferred from Bairoil to Sand Draw, Wyo.

R. E. Kellerman, formerly chief engineer, has been named executive assistant to the president of Texas Crude Oil Co., Fort Worth. **Elmer T. Ireton,** formely with Stanolind Oil & Gas Co., in Shreveport, has been named chief engineer to succeed Kellerman. **Vincent Thomas,** formerly with Core Laboratories in Fort Worth, has joined Texas Crude Oil's exploration department.

R. F. Stephenson has been named chief engineer of United Gas Pipe Line Co.'s compressor station at Tallulah, La. **W. J. Derbonne,** first engineer at United's compressor stations in Shamrock and Refugio, Tex., the past 7 years, has succeded Stephenson as chief engineer at the firm's compressor station at Rodessa, La.

DEATHS

Richard Thurman McCoy, 63, retired manager of the African marketing department of California Oil Co., Ltd., died March 26 in Westfield, N. J., after a long illness. He retired last year after 35 years with Caltex or affiliates.

Charles A. Yeatman, 51, chief mechanical engineer in Shell Oil Co.'s Los Angeles offices, died recently while in New York. Yeatman, whose home was in San Marino, Calif., joined Shell in 1927.

Earl Ifer, 68, retired driller, died March 26 at Yale, Okla., following a long illness. He retired in 1948.

Samuel J. Taylor, 45, accountant for Gulf Oil Corp., Houston, died March 28. He had been with Gulf for 25 years.

William (Billy) Muir, 102, died March 25 in St. Petersburg, Fla. He was one of the founders of the National Petroleum Association and builder of one of the earliest refineries in Pennsylvania.

Harry H. Smith, 84, pioneer Oklahoma drilling contractor, died March 25 in Tulsa. He retired in 1928.

Walter E. Brown, 66, counsel for Sinclair Refining Co. since 1942, died recently in Darien, Conn., following a brief illness. He joined Sinclair Refining in 1922.

Clifton Ray Swarts, 65, petroleum engineer, died recently near Mexico City after an illness of about 2 weeks. He retired about 5 years ago after working since about 1932 for Standard Oil Co. (N.J.), in Venezuela, Romania, and the United States. Prior to joining Standard, he was with the U. S. Bureau of Mines and Pure Oil Co.

Forrest D. McCracken, 38, salesman for Baroid Sales Division, Houston, was killed in an automobile accident near Baton Rouge, La., March 26.

Karl Brown Conway, 68, died recently in Pittsburgh after an extended illness. He joined Gulf Oil Corp. in 1909 and was assistant to the vice president in charge of production for 27 years until his retirement in 1951.

Daniel William (Bennie) Benthall, 56, with The Texas Co.'s instrument and electrical department at Port Arthur, Tex., died in Galveston, Tex., March 25.

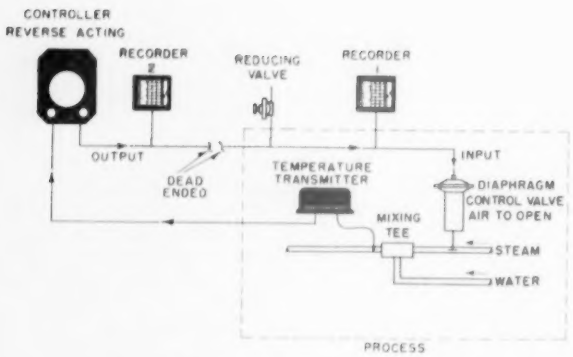
Benjamin Nelson Garrett, 72, pioneer Houston oil man, died recently. He organized Houston Bank & Trust Co. in 1915 and later became its president. Garrett developed two oil firms, Houston Deep Well Co., and Houston Goose Creek Co., and in 1919 organized Terminal Oil Co.

William Burr Adams, 57, district foreman for Gulf Oil Corp.'s Houston pipeline division, died in Sour Lake, Tex., March 28. He had been with Gulf for 38 years.

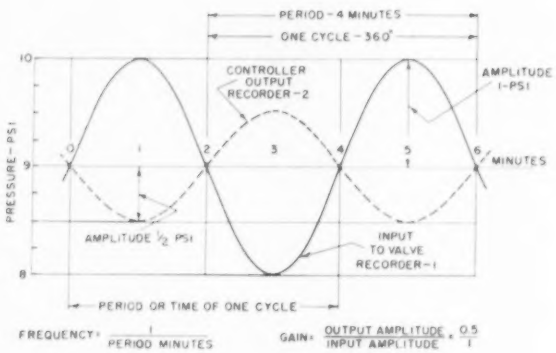
Let's take a searching look at

PROCESS INSTRUMENTATION

Here are five discussions . . . on frequency response analysis of control systems, cascade control systems, evaluation of new instruments, and continuous analysis of liquid plant streams by infrared. These articles, each authored by an expert in his particular field, present a number of new ideas and applications for the process and instrument engineer.



OPEN-LOOP components in instrumentation circuit. Fig. 1.



OPEN-LOOP frequency response test results. Fig. 2.

Frequency-Response Analysis Holds Promise

Data curves can be used for wide variety of uses

by John E. Barber

VARIOUS methods are available for solving process control problems. They can be solved mathematically but this method is so complicated that it is seldom used. They can be solved by trial and error but frequently the solutions are inadequate. Signature curves are also used, which though they can be used to determine the controllability of a process, cannot be used to adequately describe a controller.

Author is with the Application of Engineering Department, Taylor Instrument Cos., Rochester. Paper presented at fifth annual symposium on Industrial Instrumentation, College of Engineering, University of Florida, Gainesville, February 1-3, 1954.

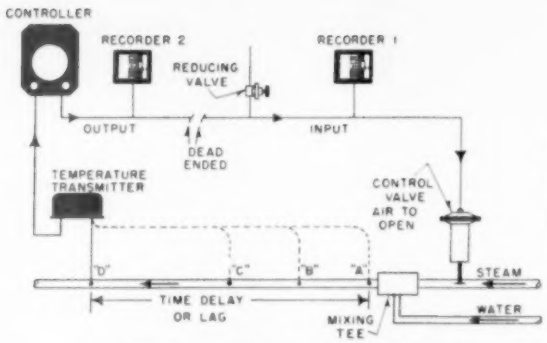
The frequency response method, based on the use of sinusoidal input pressures to study process equipment, holds promise of solving these problems.

Frequency-response data curves can be used to more completely describe controllers, to properly select controllers for specific jobs, and in some instances to determine instrument settings. It is hoped that in the future frequency-response data for process equipment will be cataloged. If it is, then reasonable predictions can be made regarding controller selection for proposed equipment without relying primarily upon the experience of an instrument engineer.

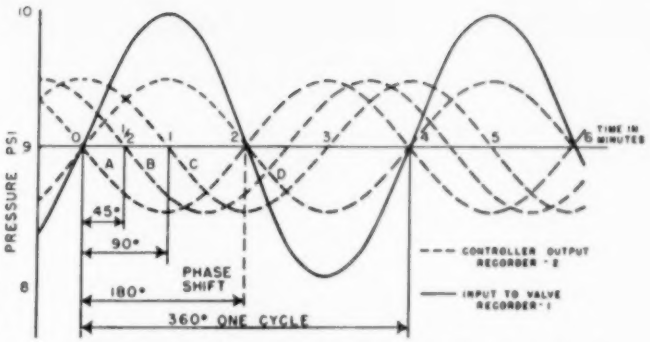
Requirements for Stability

To understand what frequency response analysis is, let us first consider the control of a simple water heater wherein a direct-acting temperature transmitter produces air input to a reverse-acting proportional-response controller. This in turn actuates the air-to-open valve regulating steam flow to the mixing tee.

When a controller and accessory equipment are properly connected and form such a closed circuit, it is referred



PROCESS LAGS in instrumentation circuit. Fig. 3.



PHASE SHIFTS are caused by lags when input is cyclic. Fig. 4.

to as a closed loop or process-control loop. The transmitter, valve, and process equipment are called the process.

The loop is opened between the controller and the valve as shown in Fig. 1. A reducing valve is installed to regulate the air pressure to the diaphragm valve. This pressure is recorded on No. 1 strip chart recorder while the controller output pressure is recorded on No. 2 strip chart recorder.

Assume that the air pressure from the reducing valve is 9 psi. and that the controller output pressure is 9 psi. For simplification also assume that there are no lags in the loop. If the reducing-valve output is increased to 10 psi. the steam valve will open, the temperature will rise, and the controller output pressure will decrease.

The fact that a reducing-valve output increase causes the controller output to decrease illustrates the corrective action inherent in any control loop. The action of the controller, valve, transmitter, and other loop components must be such that regardless of where the loop is opened a sustained load change applied to one end of the loop will result in a change in the opposite direction at the other end of the opened loop.

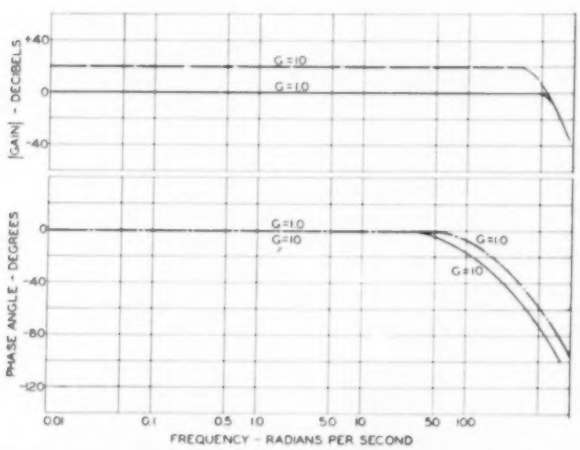
Gain is the ratio of output-pressure change to the input-pressure change. Gain of the complete loop is called loop gain. If in this case the controller output pressure decreases from 9 psi. to 8.5 psi., the gain is 0.5 psi./1 psi. or 0.5. This gain, measured with a sustained change in loop gain, is called the zero frequency loop gain.

Controller gain is the ratio of the controller output to the controller input. Process gain is the ratio of process output to process input. Loop gain is the product of controller gain and process gain.

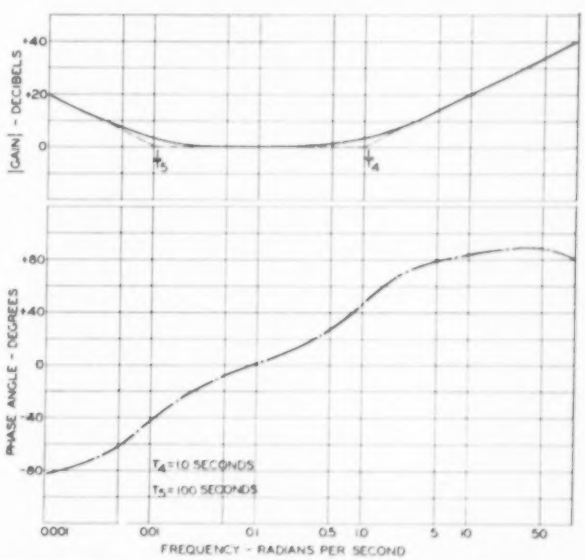
Sinusoidal test . . . If, instead of applying a sustained load change to the air pressure to the diaphragm valve, we apply a sinusoidal pressure change the records produced by the two strip chart recorders would be as shown on Fig. 2. The input pressure change (solid line) is said to have gone through one cycle when it has gone from 9 psi. to 10 (max.) back to 9 and 8 (min.) and again back to 9 psi. The period is the time to complete one cycle. The period is 4 minutes and hence the frequency is ¼ cycle per minute. The amplitude, 1 psi., is the magnitude of the peaks measured from the center of oscillation.

The controller output will oscillate at the same frequency as the cycling input. The amplitude of the output will generally differ from that of the input and will depend upon the process and controller gains and the frequency of oscillation. The change in loop gain with change in frequency depends upon the characteristics of the process and the controller. In Fig. 2 it can be seen that the controller gain setting is such that the amplitude of open loop output is 0.5 psi. The loop gain, the ratio of output to input of the open loop, is 0.5.

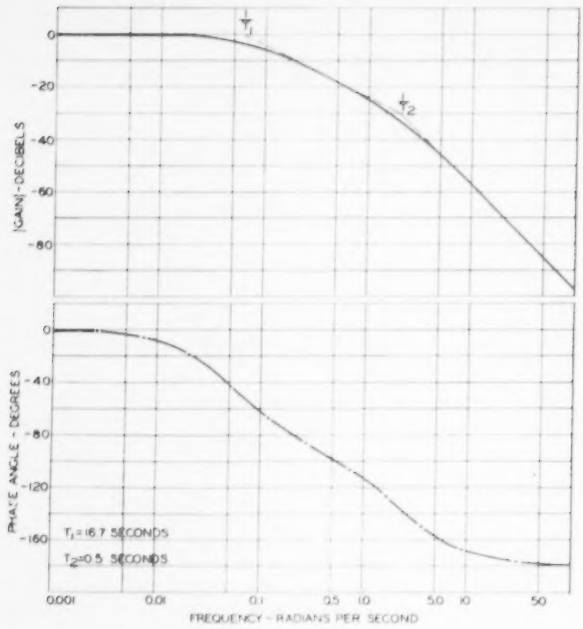
Time delay . . . Fig. 3 shows the bulb located various distances downstream from Point A at which point we considered the system to have no lag. Assume that it takes ½ minute for water to move from A to B, another ½ minute to C and 1 minute to move from C to D. Certainly the output will lag



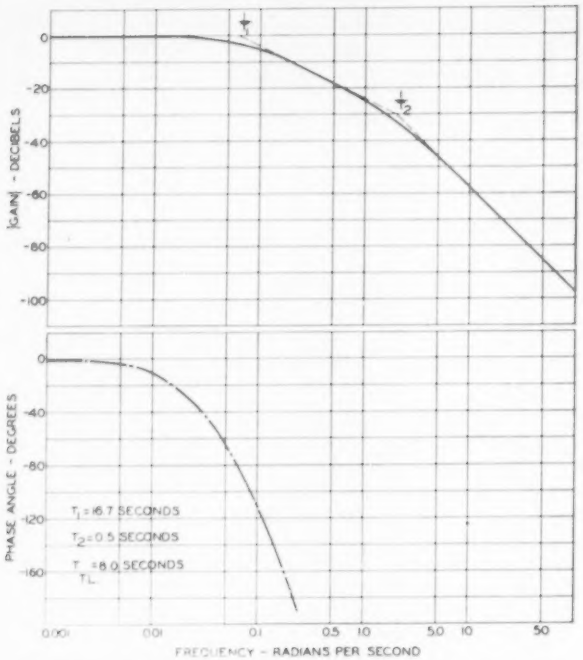
FREQUENCY RESPONSE diagram for proportional controller. Fig. 5.



RESPONSE DIAGRAM for proportional-reset-rate controller. Fig. 6.



FREQUENCY RESPONSE diagram for two-capacity process. Fig. 7.



RESPONSE DIAGRAM for two-capacity process with lag. Fig. 8.

Process Instrumentation

behind the input dependent upon the distance the bulb is located from Point A.

With cyclic inputs, time delay will cause phase lag. Lags are generally expressed in angular degrees—a full cycle being 360°. The curves for a ¼-cycle per minute input are shown in Fig. 4. With the bulb located at A (no lag) the output pressure goes to a minimum when the input pressure is maximum. The output lags the input by 180°. This phase lag will always be present due to the corrective action of the loop. Hence, we need concern ourselves only with additional phase lags. With the bulb at Location D, we find that the additional phase lag is 180° resulting in the output being in phase with the input.

Process-control loop stability depends upon the value of the loop gain when the additional phase lag is 180°. Process gain is usually fixed, hence, loop gain can be increased or decreased most conveniently by changing the controller gain.

Remembering that loop gain is the product of process and controller gains, it can be seen that as controller gain increases loop gain increases proportionately.

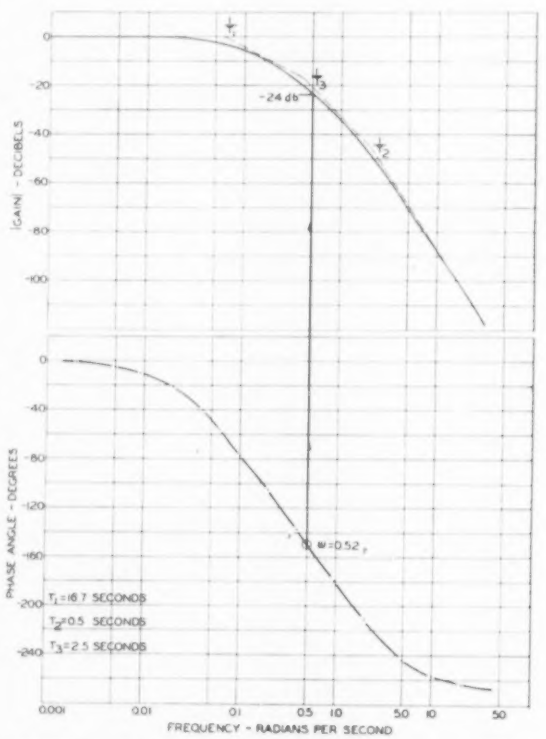
Referring again to the 180° additional lag, shown in Fig. 4, the controller gain can be increased until the loop gain is one, or until the input and output amplitudes are equal to 1 psi.

With equal input and output cycles (equal amplitude and in phase) connect the controller output to the control valve and disconnecting the reducing valve will make the closed loop oscillate continuosly. Hence when the loop gain is 1 and the additional phase lag is 180° continuous cycling will occur. This additional phase lag is made up of the lags of all the components in the loop—the controller, valve, process equipment, transmitter and connecting lines each contributing.

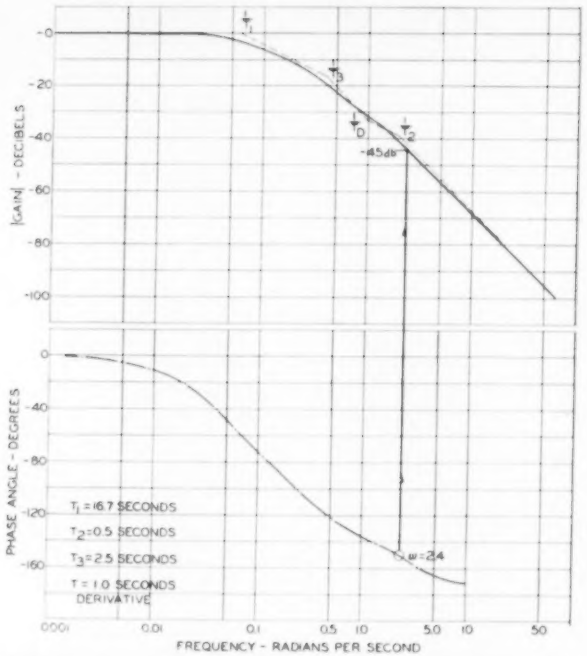
For proportional control only, the proportional gain setting required to produce a continuous oscillation with amplitude neither increasing nor decreasing is known as the **ultimate setting.** Any setting above ultimate will result in a loop gain greater than one and an increase of amplitude with each succeeding oscillation. Lower controller settings will result in damped oscillation or a decrease of amplitude with each succeeding oscillation.

Frequency response of any piece of equipment necessitates a knowledge of gain and phase lag values for a number of different frequencies.

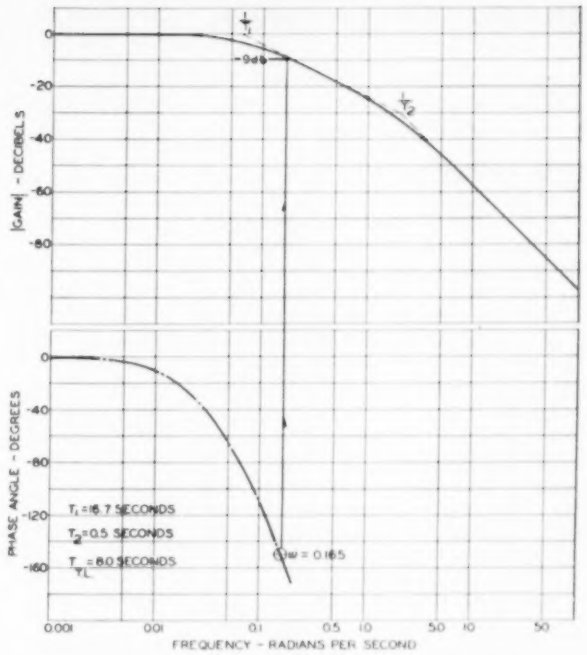
Frequency response of a typical proportional response controller is deter-



RESPONSE DIAGRAM, three-capacity process, proportional controller. Fig. 9.



FREQUENCY RESPONSE DIAGRAM, three-capacity process, plus proportional-rate controller. Fig. 10.



RESPONSE DIAGRAM, two-capacity process with lag, plus proportional controller. Fig. 11.

Process Instrumentation

mined by using a controller, a variable-frequency generator, and two strip-chart recorders, one in the controller input and one in the output. Various frequencies are imposed on the controller input and the resulting curves of the recorders are compared after the initial transient has died out.

For each frequency gain and phase lag are observed. Fig. 5 shows a frequency-response diagram for a proportional response controller. Gain and phase values are graphically represented as functions of the sinusoidal input frequency.

The frequency is usually expressed in radians per second. One cycle equals 2π radians. The phase is plotted in angular degrees. The gain is frequently plotted in decibels (db.) where the gain is db. equals $20 \times \log_{10}$ gain.

Fig. 5 shows the frequency response diagrams for a proportional response controller with a gain of 1 and a gain of 10. The diagram shows the effect of changing the gain. Changing controller gain raises or lowers the gain curve but does not appreciably affect the phase curve. It also shows that at high frequencies, the controller can no longer fully respond to the rapid cyclic variations and there is a decrease in the actual gain and a corresponding increase in the phase lag.

Automatic reset produces a high controller gain at low frequencies. This is obviously necessary if the controller is to return to the set point after a load change. There is an initial 90° phase lag introduced by the addition of reset. Increasing the reset rate shifts both the gain and phase curves a proportional amount horizontally to higher frequencies.

With derivative, the gain increases as the frequency increases until at high frequencies the gain curve follows that of a proportional response controller. More important than this is the effect on the phase angle. Derivative response contributes phase lead to the controller at high frequencies. Since all processes exhibit phase lag at higher frequencies, the offsetting phase lead contributed by the derivative response is very beneficial.

The frequency response of a controller with all three responses is shown by the curves of Fig. 6. An important feature of this diagram illustrating the advantage of the decibel coordinate is the introduction of the straight-line approximations. The straight lines intersect at two points: $1/T_4$, the derivative corner, and $1/T_5$, the reset corner. T_4 and T_5 are the time constants of the derivative and reset responses respectively. They are equal to the reciprocal of the frequency (expressed in radians per second).

At these same corner frequencies, the phase angle has reached 45° of the 90° for which each individual time constant is responsible. Phase angle for each time constant is the arc tangent of product of the frequency and the time constant. Hence, it can be seen that a calculated frequency-response diagram of the control loop can be constructed if the time constants of the controller responses are known.

Process Diagrams

As shown in Fig. 1, the process open loop consists of the control valve, the heat exchanger, and the measuring system. For simplicity, each of these process components can be approximated as an individual time constant. Each time constant in the process is responsible for an ensuing reduction in gain of 20 db. per decade and a corresponding phase lag which reaches a maximum of 90°. A two-capacity process would have a frequency-response diagram similar to that illustrated in the curves of Fig. 7.

Associated with the time constants of a process are other types of lags known as transportation lags, or dead-period lags. Thus, a temperature-measuring bulb, located Z ft. from the exchanger, would have a transportation lag (in seconds) equal to Z divided by the velocity (feet per second) of the controlled medium. Also the lag of transmission tubing can be conveniently expressed in terms of transportation lag for those frequencies with which we are concerned. There is no reduction in gain with transportation lag, but only a rapid increase in the phase lag (Fig. 8). This phase lag in radians is

equal to the product of the frequency and the transportation time.

A frequency-response diagram can be constructed irrespective of experimental work if the main time constants (corners) of the process are known. The straight-line approximation method is used to construct this calculated diagram which in most cases is very similar to that determined experimentally.

In Fig. 7 for the two-capacity process the straight-line approximations indicate that the time constants T_1 and T_2 have respective lags of 16.7 and 0.5 seconds. Each corner is responsible for an ensuing gain reduction of 20 db. per decade. Although the experimental gain curve reduction does not start to occur until a frequency of about 0.02 radians per second is reached, it is interesting to see that there has been a noticeable phase lag at much lower frequencies. Phase lag for an individual time constant is always self-evident before an appreciable gain reduction occurs. The ultimate phase lag is 180° or 90° for each corner.

The curves of Fig. 8 show the same capacity lags T_1 and T_2 but a transportation lag T_{TL} of 8.0 seconds has been added. The gain curve with or without transportation lag is unchanged. However, the phase curves are drastically different. The phase curve without transportation lag reaches a lag of 180° at infinite frequency while the phase curve with transportation lag reaches a lag of 180° at a frequency of 0.22 radians per second. The curve with transportation lag is typical since there is always some transportation lag associated with any control system on any process.

Addition of the third time constant contributes an additional 90° phase lag at high frequencies and also a faster gain reduction (60 db. per decade) at high frequencies.

30° Phase Margin

Continuous oscillation or hunting will occur if the open loop gain is one or more and the additional phase lag is 180°. However, we want stability, not continuous oscillation. The type of recovery curve following a load change is important in most processes. A criterion for good control is that the area under the recovery curve should be a minimum. Furthermore, it has been found that the minimum area under a recovery curve is obtained when the amplitude of each succeeding cycle is approximately one-quarter of the preceding cycle.

This type of recovery curve can be approximated from a frequency response diagram when the open-loop plots of the process and the control loops have been combined. The open-loop criteria for good control are a combined loop gain of 1.0 and a phase margin of 30° (150° phase lag). An open-loop plot of the complete loop is obtained by simply adding the frequency response diagrams of the open process and control loops.

Controller Plus Process

Fig. 9 illustrates open-loop frequency-response diagram of a proportional response controller added to a three-capacity process. In this case 30° phase margin occurs at a frequency of 0.52 radians per second. At this frequency, the combined gain curve has a value of −24 db. For optimum control, it is necessary to have the gain curve cross this frequency at 0 db. We can do this by raising the controller gain since by so doing we raise the gain curve but do not affect the phase curve. Hence, we need a controller gain of 24 db. or a gain of 15.9 for good control. The frequency of the recovery curve will be approximately the same as that occurring at 30° phase margin.

Controllability is improved if the area under the recovery curve is decreased. The area is a function of the amplitude and the period of the recovery curve. Hence, it would be advantageous to increase the frequency at which 30° phase margin occurs provided at the same time we increase the gain of the controller.

Fig. 10 shows a controller with a derivative added to the three-capacity process. In this case 30° phase margin occurs at a frequency of 2.4 radians per second when the derivative time is 1 second. The controller gain for good control becomes 45 db. or 178. Hence, we have increased controller gain and decreased recovery-curve period resulting in better control. If a derivative time of 10 seconds is used, the frequency at 30° phase margin increases to 4.2 radians per second, and the controller gain decreases to 32 db., or a gain of 40.

Fig. 11 illustrates the open-loop frequency-response diagrams for a proportional-response controller with a two-capacity process with transportation lag. The curves show that 30° phase margin occurs at 0.165 radians per second allowing a controller gain of 2.8 (9 db.). It is, therefore, apparent that transportation lag is extremely detrimental to process control.

Reducing Time Constants

Though it is an oversimplification, assume that the capacity lag of a tubular heat exchanger is 16.7 seconds, the lag of 0.5 seconds is due to the control valve and the transportation lag of 8.0 seconds is composed to a transportation lag of 4.0 seconds and transmission tubing lag of 4.0 seconds. Let us try to reduce these values and note the results.

The lag of the heat exchanger might be reduced to 10 seconds by installing a circulating pump to increase the velocity through the exchanger. The transportation lag might be decreased to 1 second by locating the bulb closer to the heat exchanger. By close-coupling the controller, transmitter, and valve, the tubing lag may be decreased to 1 second. This gives a total transportation lag of 2 seconds. Close-coupling the controller and valve may decrease its time constant to 0.4 second. In the improved process, the controller gain of 30° phase margin is 5 (14 db.) instead of 2.8 (9 db.), the frequency is 0.5 radians per second instead of 0.165.

Conclusions

Frequency-response analysis provides a new tool for the instrument engineer. With it he can learn more about controllers and processes. It is also possible to combine frequency-response diagrams of the various components of a process control loop and predict the performance of a control system without actually installing and testing the complete unit. Hence, the effect of design improvement can be predicted. However, to do this, it is imperative that frequency-response data on process equipment be available. In time it is hoped that at least for the simpler types of process equipment frequency-response data will be made available and hence the task of applying instruments to processes will be simplified.

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Liquid Stream Analyzers Lag

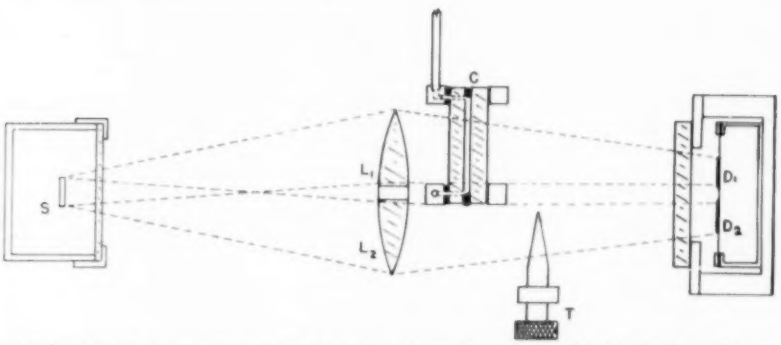
In the past 7 or 8 years, since the beginning of the general use of continuous infrared analyzers on plant streams, there has been a notable lag in the number of liquid stream applications as compared to gas applications. A check through a list of around 20 references to infrared analyzer publications in the files, shows that they run 85 per cent for gas applications.

The reason, certainly, is not that the liquid streams exist in lesser abundance, nor can it be explained entirely on the basis that liquid streams are more applicable to analysis by other methods, such as refractive index and specific gravity, since these methods are quite limited in their usefulness.

At Dow Chemical Co.'s Midland, Mich., plant 50 per cent of the infrared analyzer applications are for liquid streams. In many cases, however, suitable commercial instruments for liquids were not available, and the equipment had to be constructed in the laboratory. Commercial instrument manufacturers have been concentrating development on the more readily solved problem of gas analyzers, so that until recently,[1] and even to some extent at present, delivery quotations on infrared analyzers for liquid streams have not been satisfactory.

In making presently available infrared analyzers generally applicable to liquid streams, beside the need for conversion to liquid cells, there are certain other problems which we will discuss later. The result is that each liquid stream application is usually considered as a special case.

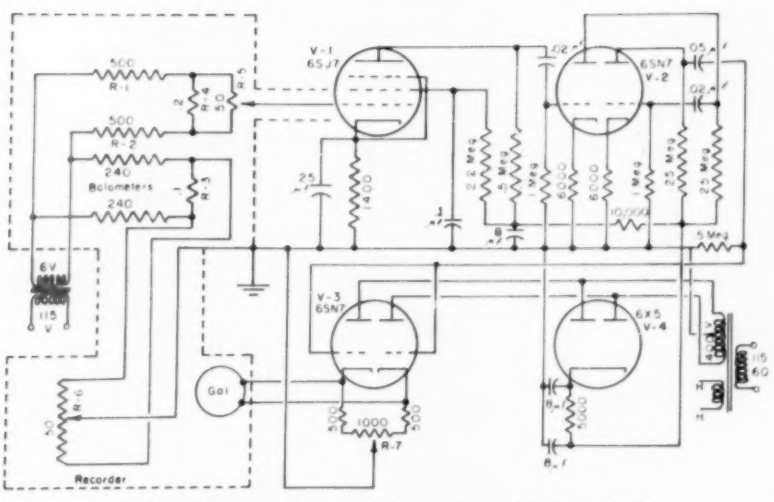
PROCESS INSTRUMENTATION



SIMPLE OPTICAL arrangement for infrared analyzer. System is stable for ideal conditions. Fig. 1.

Continuous Analysis of Liquid Plant Streams by Infrared

by L. W. Herscher



ELECTRICAL CIRCUIT for simple analyzer of Fig. 1. Fig. 2.

THE use of infrared analyzers for liquid streams should expand at such a rate as to overtake gas analyzers in the near future.

This will come about partly through further adaptations of the present nondispersing instruments. A large part, however, will result from the forthcoming availability of spectrometer analyzers, the only type fully as applicable to liquid as it is to gas streams.

These should do much to accelerate the expanding use of infrared analyzers in general, but the greater impetus can be expected in liquid stream applications because of the backlog which has developed in this field.

Liquid Stream Analyzers

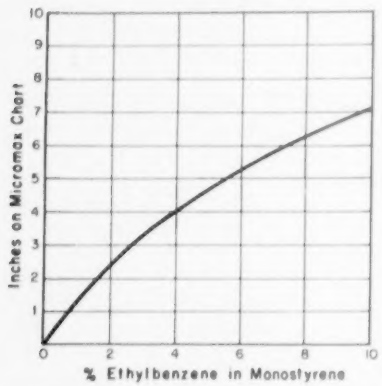
Total absorption type . . . The simplest, and probably the earliest infrared analyzers for liquid streams, were for two component mixtures, usually where one of the components is present as a low per cent of impurity. A good application of this type of analyzer is in the finishing distillation of styrene monomer for separation of ethyl benzene. Ethyl benzene has strong infrared absorption around 3.4μ. This wave length is close to the energy peak of radiation from a nichrome coil source at dull red heat.

Under these ideal conditions, it is possible to use the simple optical arrangement of Fig. 1 for a stable sensitive analyzer. Light from the source S is divided into two beams by the split lens L_1-L_2. A continuous sample flows through the cell C in a thin layer, about 0.005 in. thick, where it is traversed by the beam from L_1. The other beam passes beside the sample cell as a reference beam, and it is balanced initial-

Author is with Dow Chemical Co., Spectroscopy Laboratory. Paper presented at ninth annual symposium on Instrumentation for the Process Industries, Texas A. & M. College, January 27-29, 1954.

ly by means of the light trimmer, B, to give minimum effect from small changes in the source voltage.

The detectors, D_1 and D_2, are light nickel wire resistance thermometer elements in an a.c. wheatstone bridge. A decrease in transmission of the light in the sample beam, due to the presence of ethyl benzene, will cool D_1 causing the recorder to move to a new balance point. The electrical circuit is shown in Fig. 2. A calibration curve, such as



CALIBRATION CURVE for simple infrared analyzer. Fig. 3.

Fig. 3, is obtained by running a series of mixtures made up to known concentrations.

The cell in Fig. 1 should be absolutely liquid-tight and easily removable for replacement. The construction shown has proved very satisfactory. The two optical windows are separated by a continuous lead shim with its center cut out. One of the windows is drilled with two holes entering at opposite corners of the opening in the lead shim. Two metal plates, with clamping screws, are used to hold the assembly together.

One of the clamping plates is drilled with holes that match those in the window and then connect to the ⅛-in. tubing leads which are welded into this plate. To make a tight cell, the windows are ground flat to about six fringes, and the lead shim is wet with mercury before assembly. Mercury-coated lead washers are also used to seal at the holes between the drilled window and metal plate. The undrilled window is backed up with a rubber gasket to give even distribution of the clamping pressure.

This instrument is sensitive to less than 0.1 per cent ethyl benzene. The fact that the analyzer is not specific for ethyl benzene is often an advantage. The presence of almost any possible impurity would be indicated, not necessarily in the correct amount, but at least a warning of any unusual conditions in the process is given.

For instance, the analyzer is sensitive to moisture in the parts per million range. However, the nonspecificity of this type of analyzer does limit its usefulness to a relatively small field. Fig. 4 shows a plant installation of an analyzer of this type with explosion-proof housing open. The amplifier seen in the upper part of the housing is required when a galvanometer-type recorder is used.

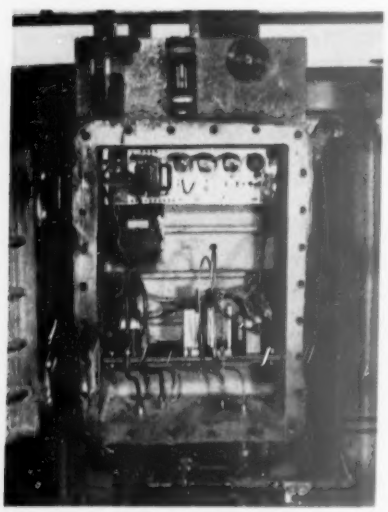
Positive filter type . . . By adding a light chopper and substituting a selective detector, such as a gas-filled condenser microphone for the bolometer detectors in Fig. 1, a positive filter-type infrared analyzer could be made. This type is fundamentally for gas analysis, and its application to liquid streams has not been fully exploited. The difficulty lies in the chance possibility of finding a suitable gas to fill the detector. This would require a gas with absorption bands at the wave lengths at which the compound to be determined absorbs, and preferably no bands where they could cause interference from other components of the stream.

In some cases, especially with operation at elevated temperature, the liquid to be measured may have a high enough vapor pressure itself to be used for sensitizing the detector. From 15 to 75-mm. pressure is usually sufficient. However, one should first compare the spectrograms of the compound in the liquid and vapor phases, because there may be important differences in the wave length and intensity of certain bands.

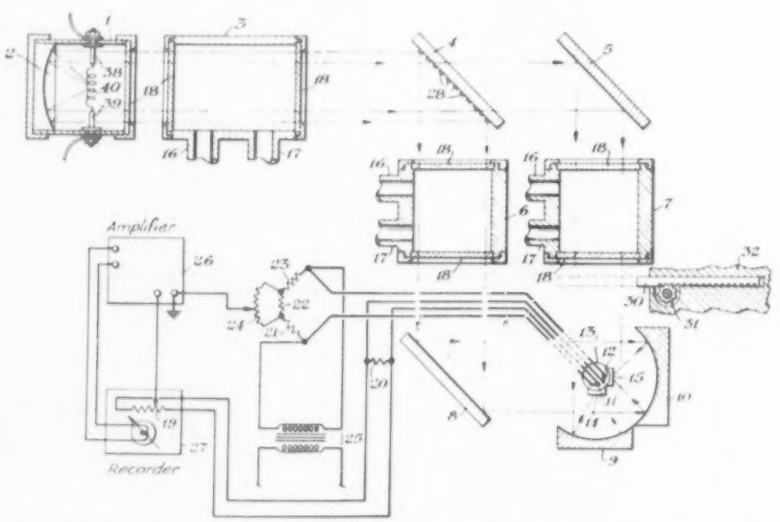
Negative filter type . . . This type of infrared analyzer has proved successful for some of the liquid stream applications. The system is comparable to the positive filter method as to selectivity for a particular component of the stream, but is somewhat more generally applicable to liquids because the detector filling problem is avoided. This is also a popular type for gas analysis.

Fig. 5 is a schematic of the optical plan of a special design of this type of instrument. This particular optical arrangement was originated at Dow to obtain certain advantages over other available negative filter analyzers. Light from the source, 40, is collimated by the mirror, 2, and passes through the sample cell, 3. The plate, 4, is coated with evenly distributed reflecting spots which aggregate half of the total area of the plate.

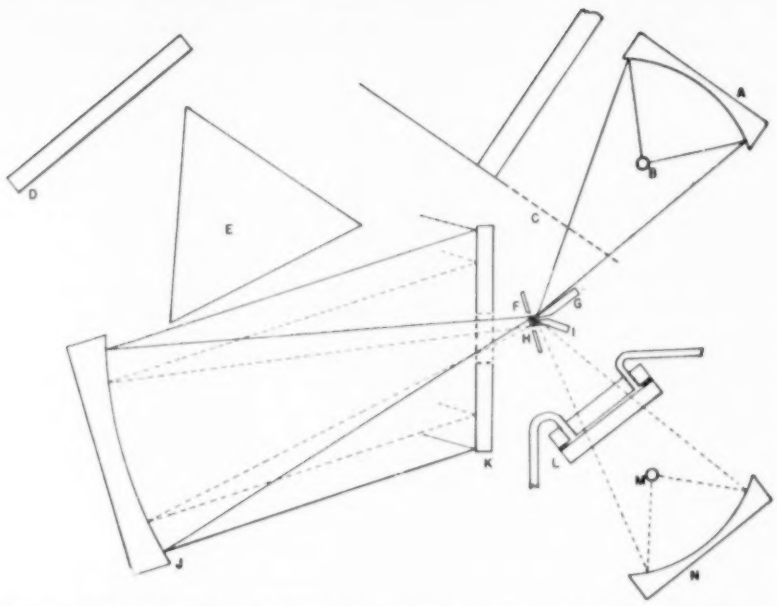
This divides the light into two por-



PLANT INSTALLATION of simple infrared analyzer. Fig. 4.



OPTICAL PLAN for a special design of negative filter type of infrared analyzer. Fig. 5.



SCHEMATIC OF OPTICAL SYSTEM for spectrometer type of infrared analyzer. Fig. 6.

tions, a reference beam and a measuring beam, one of which is transmitted through the plate and the other reflected. This beam-splitting method divides equally between the two beams, light from all parts of the source and from all parts of the sample cell. This results in a system which is practically immune to drifts which might arise from dirt or coatings accumulating on the source mirror or windows of the source and sample cell.

After separation, the beams are far enough apart to provide room for solidly constructed leakproof cells in either or both of the beams. Also to facilitate the original sensitizing and later maintenance, each of the cells is entirely separate so that it can be removed without disturbing any of the other components.

The two beams are brought back together by the diagonal mirror, 8, and condensing mirrors, 9 and 10. The condensing system focuses the beams, one on each of the two 4-mm. square bolometer detectors mounted at a right angle to each other. By concentrating the light onto this small area, a temperature rise of the detectors is produced which is three or four times greater than that usually obtained, giving a corresponding improvement in immunity to ambient effects.

In common with all of the negative filter type, this analyzer depends for its operation on a filter substance placed in the reference beam. This filter must have strong absorption at the wave lengths at which measurement is required for the analysis. Normally one uses the compound of interest itself for the filter substance. This is not always possible, however.

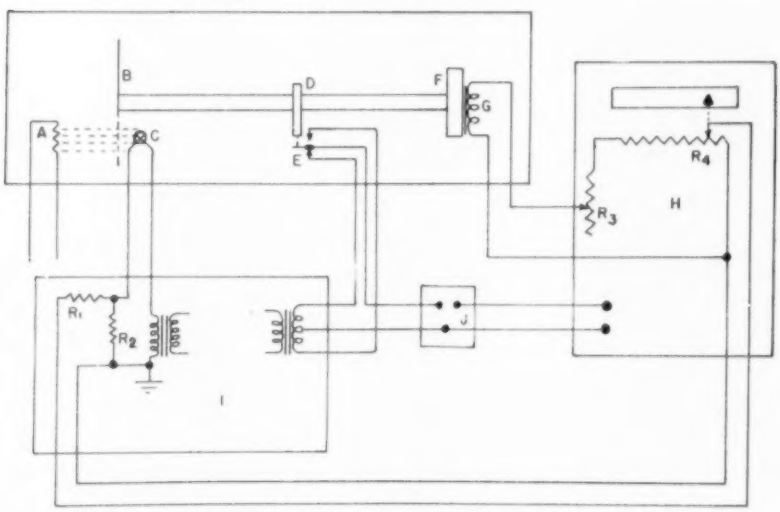
There is the difficulty of keeping a liquid with high vapor pressure sealed in a cell for a long time. Also, any liquid which might polymerize could not be used. The absorption bands of liquids are usually broad which may present a problem of interference from other components in the stream. For certain applications it is possible to find a plastic film or gas suitable for the filter substance.

Spectrometer type . . . A model of this type was developed in 1951 for a particular problem at Dow and was described in a recent publication.[2] It has proved so successful that it is gaining preference even for some applications formerly being done satisfactorily with the nondispersing-type analyzer, and several are now in use in the plants.

In contrast to the nondispersing analyzer, which depends on various filter substances to gain selectivity, the spectrometer analyzer uses a prism to disperse the infrared radiation of the source into a continuous spectrum. Then in conjunction with an entrance and exit slit pair, the optimum wave length for a particular analysis can be selected and the sample transmission measured at this wave length.

Such instruments have been used in the laboratory for analysis for a good many years, but they have not been suitable for routine plant installation because of size and complexity. To meet the requirements of plant installations, a spectrometer was designed sufficiently compact to fit into a standard 11 by 13 by 7-in. explosionproof housing. A similar enclosure contains the electronic equipment, the output of which is used to operate any standard recorder or controller to present the analytical results.

Fig. 6 is a schematic of the optical system. The source, B, is a small nichrome helix heated with about 14 watts input. It is focused by mirrors, A and G, through the entrance slit, F. The radiation then passes through a hole in the plane mirror, K, is collimated by mirror, J, passed through the prism and returned by the same path to J, which now focuses the dispersed



NULL-BALANCE recording system for spectrometer type of analyzer. Fig. 7.

spectrum at the region of the exit slit, H.

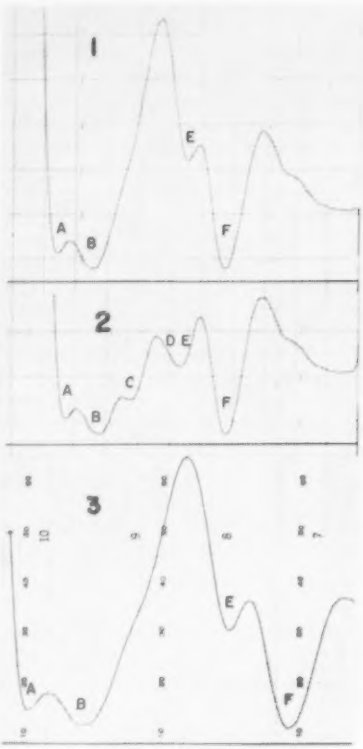
Wave length selection is made by adjusting a screw which controls the angle of the littrow mirror, D, so that light of the desired wave length falls on the exit slit. After leaving the exit slit, the light passes through the continuously flowing sample in cell, L, and is then condensed on a fast responding radiation thermocouple, M. For ease of amplification a.c. output from the thermocouple is obtained by chopping the light at 6 cycles per second with the rotating shutter, C.

Fig. 7 is a schematic of the null-balance recording system. The a.c. output of the detector is balanced against a fraction of a 180 out of phase voltage generated in the pickup coil, G, by the rotating magnet, F. The amplifier, I, amplifies any unbalance signal, which is then rectified by the syncronons switch, E, filtered at J, and then applied as d.c. of the proper polarity to the recorder input. The recorder slide wire is then automatically positioned to control the fraction of the generator voltage appearing across R_2 to restore balance. R_3 is a span control.

Fig. 8 is a photograph of the spectrometer inside its explosionproof housing.

As an example of the method of analysis with this instrument, it was originally designed to analyze a liquid stream of meta and para ethyl toluene for minor concentrations of the ortho isomer.

Curve 1, Fig. 9, shows a portion of the infrared spectrum in the region of 13μ of the meta and para ethyl toluene mixture, recorded with the analyzer using a temporary scanning attachment. Curve 3 shows the same spectrum recorded on a commercial laboratory spectrometer. Curve 2 is a scan of the same spectral region of a meta-para mixture containing 10 per cent ortho ethyl toluene. This shows the strong absorption of ortho in the region at D.



PORTION OF INFRARED spectrum for mixture of ethyl toluene isomers. Fig. 9.

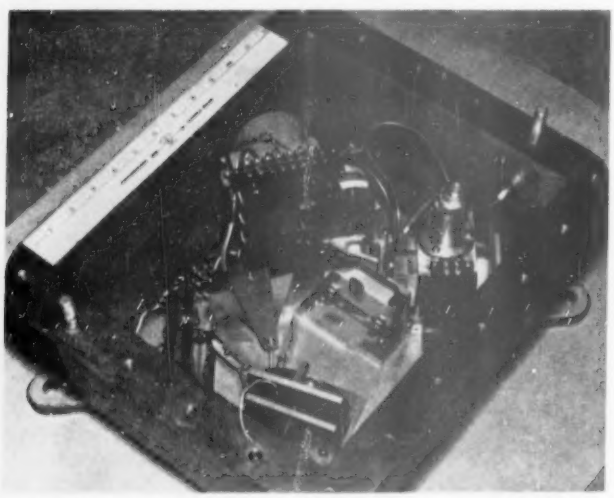
For continuous analysis, the wave-length control is adjusted and fixed to transmit light at the energy peak between absorption bands, B and E, of the meta-para mixture (where ortho has strong absorption), and the sample transmission is simply recorded at this wave length. The response is little affected by changes in the meta-para ratio. An indication of the sensitivity can be seen from a comparison of Curves 1 and 2 where we see that approximately 60 per cent of the light is absorbed by the addition of 10 per cent ortho to the mixture.

The source output at this wave length is held to better than 1 per cent by an ordinary constant-voltage transformer-type regulator. Standardization is done two or three times per week by introducing a known sample and adjusting R_3 if required. This is actually a span adjustment to correct for possible losses in efficiency of the optical system or source and detector. Zero drift is practically nonexistent.

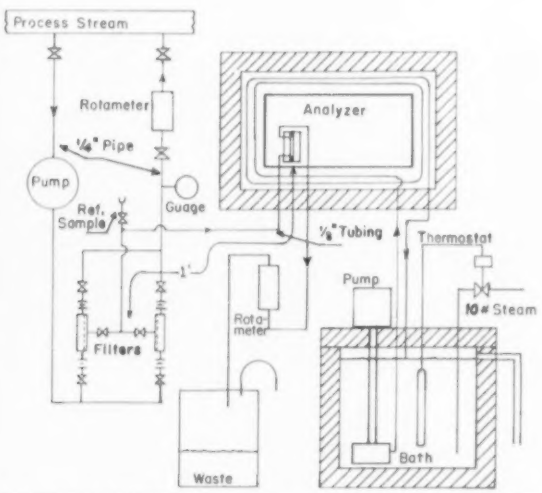
An analyzer of this type avoids the problems encountered with the filter-type analyzers discussed above in regard to finding a substance for filling the filter and detector cells, and also the continued uncertainty of maintaining the original filling conditions. Its applicability to a new problem can be readily determined by looking at the infrared spectrograms of the substances present in the stream.

The less-frequent standardization required indicates that these analyzers are less subject to drift than other types, and none of the applications to date have required thermostating of the analyzer housing. Furthermore, this type has the advantage of adaptability to multipoint recording of several components in a stream.

Manufacture of this type of analyzer



SPECTROMETER TYPE of instrument fits very compactly inside its explosionproof housing. Fig. 8.



SAMPLING SYSTEM for analyzer, designed to meet particular plant problems. Fig. 10.

is being considered by an instrument company; also another spectrometer analyzer, of somewhat different type and operation, has been announced recently and should soon be available.

Sampling Liquid Plant Streams

An improperly designed sampling system for the particular application can easily ruin the performance of an otherwise good analyzer. Fortunately, modifications of the original sampling system can be made if the first operations show they are needed, but this adds to the expense of installation and results in a loss of prestige for the analyzer, besides putting it out of operation when it may be needed most. Part of the difficulty is that there is no universal sampling system which is best for all applications.

The factors of viscosity, sample temperature, cell restriction, filtering, inlet and return line pressures, rate of flow, time lags, drying or scrubbing where necessary, and the mixture for standardizing are all factors to be considered in planning the sampling system for a particular application. It can be readily seen that virtually each one of these factors is interdependent on one or more of the others.

For example, any drying, filtering, or scrubbing systems in the line add to the sample inventory which in turn determines the rate of flow required for a given time lag. Perhaps these interrelationships can best be shown by these simple formulas:

$$T = I/F$$

where:

T = sampling time lag
I = volume of sample inventory
F = flow rate

Also:

$$F = c\,\frac{P_1 - P_2}{RV}$$

where:

C = a constant
P_1, P_2 = inlet and outlet pressures respectively
R = flow resistance of the system, (for liquid streams, usually the cell restriction is the largest factor in determining R)
V = a function of the viscosity

To arrive at a solution with a minimum number of trial substitutions, we can first select the factors over which we have no control or which can be in a limited range only. One of these is the time lag allowable, and this can be determined from consultation with the process engineers. However, the design should be weighted toward more rapid response than absolutely necessary for more satisfactory operation generally.

A second factor where there is little flexibility is in the restriction of the cell to the flow of sample. This is determined, chiefly, by the cell window spacing which in turn is chosen by the spectroscopist to fit the analytical problem. Experience indicates, however, that thicknesses up to twice the optimum spectroscopically, can be used where required by flow rate considerations.

This spacing usually ranges from 0.001 to 0.010 in., and in the case of a viscous liquid, at 0.002 in. spacing, there is a serious limitation to the amount of fluid that can be put through the cell at a reasonable pressure. Some decrease in the cell restriction can be obtained by grooving one of the cell plates across the inlet and outlet sides so that the fluid pressure is applied across the entire widest dimension of the cell opening.

Applied pressure . . . The pressure applied to standard cells should be limited to 20 to 25 psi. In order to obtain maximum flow rate for the limited inlet pressure, the outlet should be discharged at zero or negative head. If a suitable low-pressure discharge point is not available in the process, the small stream from the analyzer (in the order of a few gallons per week) may be discharged into a vented container and returned to the process by pump or manually.

Raising of the sample temperature offers another degree of freedom in the operation of the analyzer. By this means the viscosity can be reduced where necessary to increase flow rate, and also some fusible solids can be liquefied and successfully analyzed by infrared. Since standard analyzers are not designed for heating the sample cell alone, it is necessary to operate the entire analyzer at the elevated temperature. Some analyzers are equipped with thermostating equipment which is good up to about 150° F.

Sampling problem . . . Fig. 10 is a diagram of a system designed to meet somewhat adverse conditions of a sampling problem. Stream has a viscosity of 250 cp., roughly equivalent to molasses at room temperature. It contains about 1 per cent of jel solids which have amazing capacity for quickly sealing off almost any type of filter. Also the analyzer is on an automatic control system which requires a fast response time.

In the operation of the system a ¼-in. side stream is piped a distance of about 15 ft. to a pair of interchangeable filters directly beneath the analyzer. The pump delivers about 1 g.p.m. against the 20-psi. head which is controlled by the valve below the rotameter. The filter design and flow rates give a ratio of velocity across the screen about 15,000 times the rate through the screen which is fairly effective in keeping the jels swept out. Two-hundred-mesh screen is used. After 1 to 2 days' use, the alternate filter is put into operation, and a new screen is installed in the previous filter.

The cell spacing is 0.004 in., and a groove is cut across the cell window opening at the inlet and outlet to reduce the restriction. To reduce the viscosity of the fluid, the analyzer is insulated and heated to 130° F. with circulating hot water in a ¼-in. copper-tubing coil attached to the analyzer's explosionproof housing. Under these conditions, the 20-psi. pressure produces a flow rate of around 5 cc. per minute through the analyzer cell.

The volume of the 1-ft. run of ⅛-in. o.d. tubing is 0.3 cc. with an additional cc. inventory on the analyzer side of the screen in the filter. These values indicate an over-all response time of about 30 seconds. The analyzer is checked for zero drift at 24-hour intervals by injecting, with a hypodermic syringe, a 10-cc. reference sample at the fitting provided.

For more common applications of low viscosity and no unusual filtering problems, the bypass stream may be eliminated. For example, if the analyzer can be located within 50 ft. of the process stream, a direct ⅛-in.-tubing sample line would have a volume of about 15 cc. With a 0.004-in. cell window spacing and 20 psi. differential across the system, a flow rate of about 20 cc. per minute could be maintained giving a sampling time of under a minute.

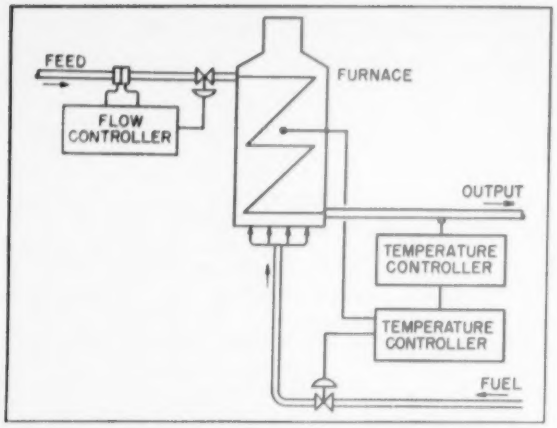
A small automotive gasoline-line filter has been found to meet the filtering requirements for a dry and relatively clean stream where this order of flow rate can be obtained. It can be placed in the direct line to the analyzer without seriously affecting the inventory.

References

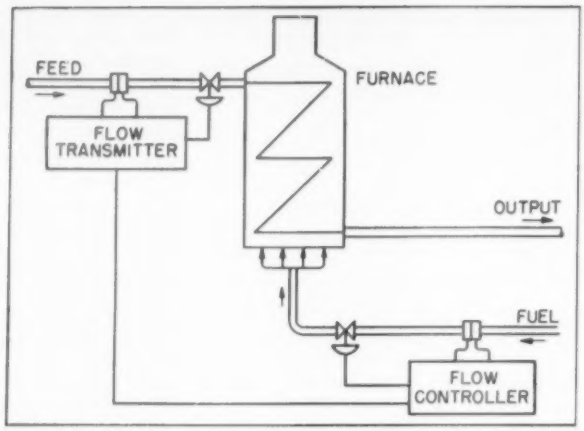
1. Process Controls Division of Baird Associates, Inc., Cambridge 38, Mass., has announced availability of liquid cell equipment for their negative filter-type infrared analyzers.

2. L. W. Herscher and N. Wright "Small Spectrometer Analyzer for Chemical Process Streams," Journal of the Optical Society of America, Vol. 43, No. 11, pp. 980-983, Nov. 1953.

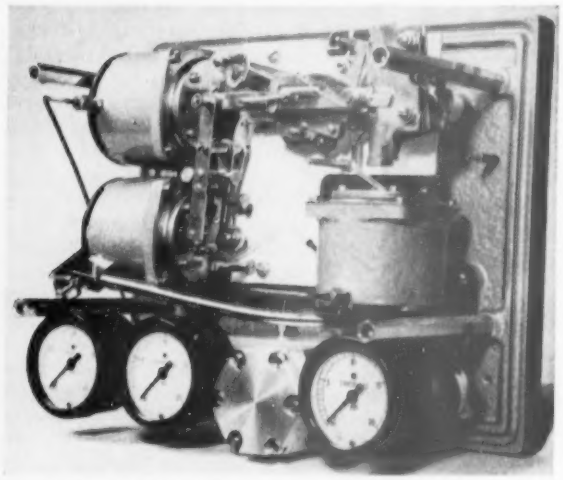
3. Perkins-Elmer Corp., "Two Wave-Length Infrared Plant Stream Analyzer," Instruments Vol. 26, No. 4, p. 514, April 1953.



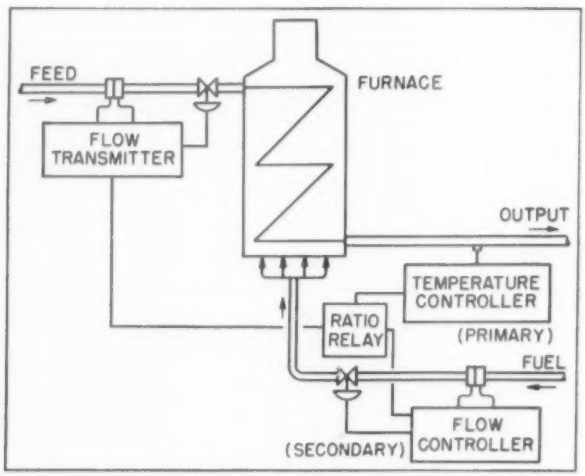
TEMPERATURE-TO-TEMPERATURE cascade control. Fig. 1.



RATIO FLOW control system, fuel to demand. Fig. 2.



RATIO RELAY device for use in air-control systems.



CASCADE CONTROL using ratio relay. Fig. 3.

PROCESS INSTRUMENTATION

Some New Aspects of Cascade Control

by C. W. Bowden, Jr. and Harry Hartz

CASCADE control is a system in which two related variables are interlocked in one control loop. The prime justification for cascade control is sufficient lag in a system to prevent precision results with a single controller.

In practice, cascade control is accomplished by use of the output of a primary controller to adjust the set point of a secondary controller on a related variable. The classic example of the need for cascade is to regulate output temperature from a tube-type furnace such as a Petro-Chem furnace.

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Furnace control . . . The simplest control setup for this furnace provides for a flow controller on the feed, and for a temperature controller on the output. This simple system might produce excellent results if load changes could be prevented from affecting the process.

Actually there are several factors which produce load changes in a tube furnace. They include furnace temperature, furnace efficiency, fuel pressure, fuel composition, as well as ambient-temperature variations. All of these variables are subject to change and at differing rates. Thus, there are serious load changes which must be corrected for.

In a unit such as this furnace, the internal temperature will respond quite rapidly to a change in fuel flow. Product temperature, on the other hand, responds much more slowly because of the time required for the additional heat to penetrate through the tubes, and also because the full effect of the higher furnace temperature is not felt until all of the product in the tubes at the time

of the change has passed entirely through the furnace. Consequently there is quite a lag in product-temperature measurement.

In a situation where load changes are frequent, and occur at differing rates, and where the problem is further complicated by measuring lags, precise control from a simple loop is difficult to obtain. This is exactly the kind of application where cascade control is justified. The cascade arrangement controls one of the previously unregulated variables, and therefore greatly simplifies the control problem.

The usual cascade arrangement for a tube furnace is to add a full flow controller to the simple control system. Now instead of using the output of the temperature controller to operate the fuel valve directly, the signal resets the fuel-flow controller. This eliminates upsets resulting from fuel-pressure fluctuation and significantly improves control results.

Even with this system, however, several variables are still uncontrolled. Furnace temperature, furnace efficiency, fuel composition, and ambient temperature still change and produce upsets. It is evident that these variables are directly related to furnace temperature. It would seem practical, therefore, to utilize furnace temperature as the secondary variable rather than fuel flow.

New system . . . A temperature-to-temperature cascade control system has often been used in the relatively small Petro-Chem furnaces. The system is illustrated in Fig. 1. Since the internal furnace temperature responds rapidly to adjustments in fuel supply, flow control is not required. In spite of the fact that there are some problems involved in furnace-temperature measurement, the system produces quite satisfactory results.

To the writers' knowledge this temperature-to-temperature cascade system has never been applied to large horizontal-tube furnaces because of the obvious difficulty in obtaining a representative temperature measurement under varying firing conditions.

Although cascade control of temperature in a Petro-Chem furnace gives satisfactory results, the system is predicated upon a constant supply of product to the unit. Flow control is necessary on the product supply line to insure constancy. Even so, it is highly unlikely that a constant supply is obtainable without considerable upstream surge capacity.

Today, high construction costs are leading design engineers to search for every possible means for cost reductions. Surge capacity is one of the prime targets. Actually, in a few of the most modern plants, surge capacity has been reduced almost to the vanishing point.

If surge capacity upstream from the Petro-Chem furnace is drastically reduced, we can no longer be sure of constant product supply even if a flow controller is employed. Each change in product flow rate will result in product temperature error, but the error will not be detected until the incorrectly heated material has been discharged from the furnace. At this time, though, the controller will begin to correct for a situation which may no longer exist. The result can be chaos.

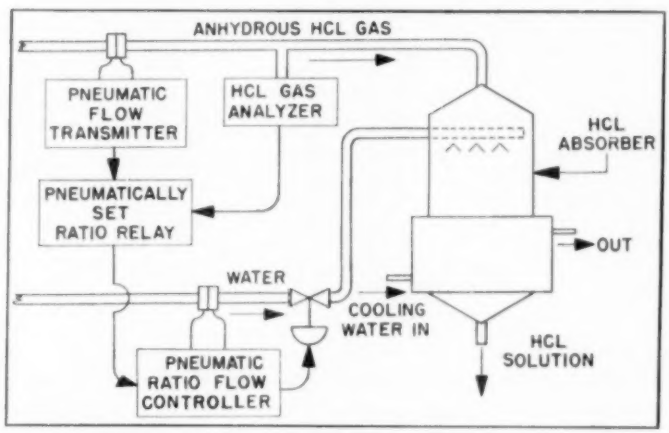
Ratio flow control . . . If supply of product to the furnace cannot be stabilized because no capacity exists upstream, it is necessary to regulate furnace fuel in accordance with demand. Of course, this immediately suggests ratio flow control (Fig. 2). Actually, ratio flow control is a form of cascade control. A signal from the primary or "wild" flow meter adjusts the set point of the secondary flow controller.

The adjustment in the secondary controller may be preset to any ratio from 25 to 141 per cent of the primary flow. The ratio, once set, remains constant. Regardless of primary flow variations, the secondary flow is regulated so that it always remains at the same percentage of the primary.

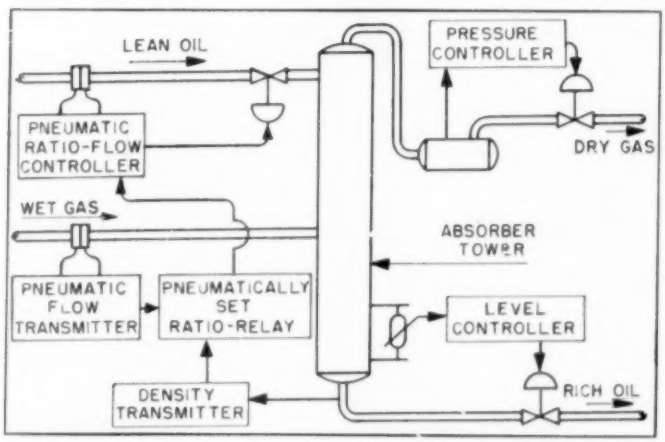
There is an important difference between ratio flow control and the closed-loop cascade control previously considered. In ratio control there is an open loop. That is, nothing measures the final result of the control system.

If a ratio flow system is used on a tube furnace satisfactory control might result if no load changes should occur to require an alteration of the preset ratio. Unfortunately, however, all of the factors which produce the load changes are still present. In other words, product temperature must be measured and adjusted to hold it constant.

This might easily be done if the signal from a temperature controller



MODIFIED RATIO-FLOW control of a hydrogen chloride gas-absorption system. Fig. 4.



RATIO-FLOW control of a hydrocarbon gas-absorption system. Fig. 5.

could be used to make necessary modifications to the ratio system to maintain correct temperature. Such an arrangement would "close the loop" to give true cascade control.

Ratio relay . . . Quite recently a device has been produced which makes such a system possible, as shown in Fig. 3. This arrangement ties down practically every important variable in the operation of a tube furnace and lends high flexibility of operation.

The device (shown in an accompanying photograph) is actually a pneumatic-set ratio relay for use in air-control systems. It receives two input pressures and transmits an output pressure, all in the standard 3-15-psig. range. The output signal is proportional to the first input signal, called "A," but the proportionality is regulated by the second input, called "B." The actual affect of "B" on the ratio of "A" to "output" depends upon relay adjustments.

There are two separate linkage adjustments—span and zero. Upper and lower limit stops are also provided. Span is fully adjustable up to 200 per cent and zero can be moved from minus 200 to plus 200 per cent. This, of course, gives high flexibility.

Operation of the relay can be expressed in simple mathematical terms. Without any positive or negative zero suppression the equation is:

$$A \times BK = \text{output}$$

where K is the span adjustment.

Of course, K cannot be greater than 2 and the output cannot exceed 15 psig. If the effect of zero suppression is added to the equation it becomes:

$$ABK + S = \text{output}$$

In this case "S" equals zero suppression. It can vary from —2 to +2.

One of the most important features of this relay is linearity of ratio. In other words, the relay is actually a pneumatic multiplier and accordingly it is a simple analog computer. A highly flexible device such as this relay can be used to solve many difficult control problems and greatly increases the possibilities of cascade arrangements.

Ratio flow application . . . The relay may be used to help simplify a control problem in the case of the ratio flow controller previously considered. If the flow meters' ranges were carefully selected so that under average conditions both meters read 70 per cent of scale, the relay would be adjusted so that at the desired output temperature the ratio would be 100 per cent or 1-1.

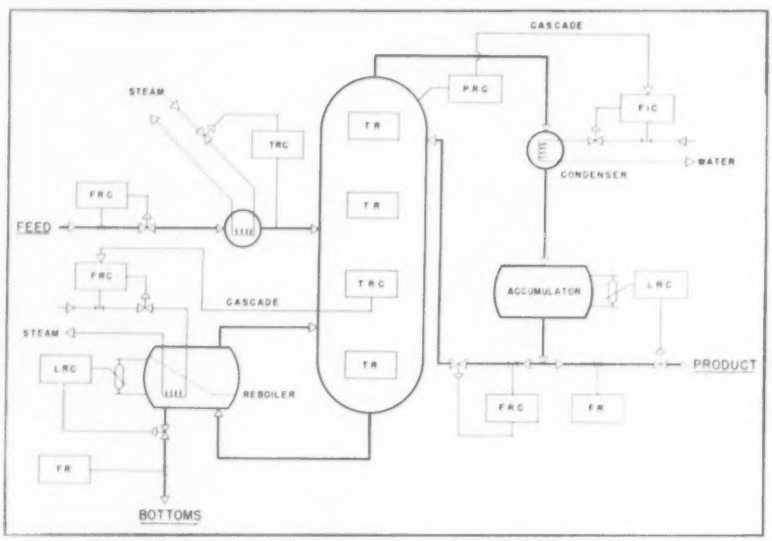
Each change in product input to the furnace would result in a proportional change in fuel flow with a minimum of lag. If a load change occurs and product temperature begins to rise, ratio of fuel to product must be changed to lower this temperature. The signal from the temperature controller to the relay makes the adjustment. Of course, in this example a temperature rise necessitates a reduction in fuel or a decrease in ratio. The relay can easily handle the requirement, however, because its output can be either direct or reverse.

In this control application the limit stops of the relay perform a very useful function. Since no burner can be operated below a certain minimum fuel flow, one stop can be set so that fuel cannot fall this low. Too much fuel, on the other hand, can cause furnace damage and the other stop can be set to prevent this contingency.

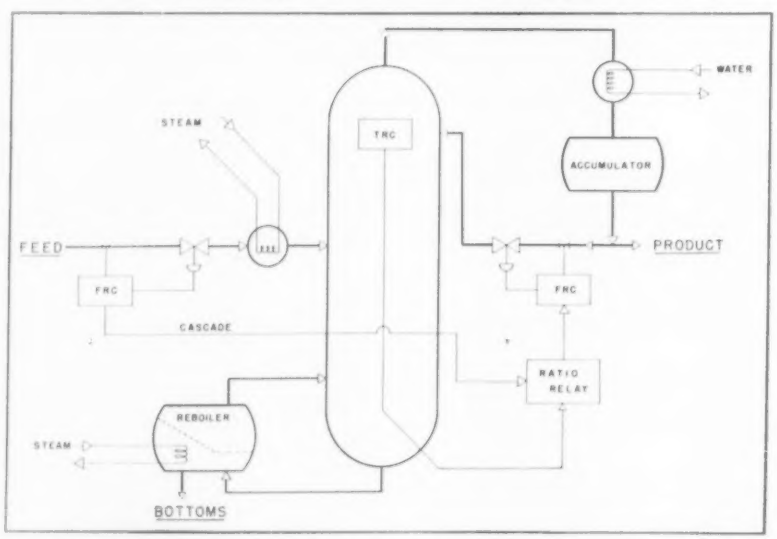
A ratio flow problem such as this may appear unique, but it is quite surprising how often it has appeared during the current expansion period, particularly where natural gas was the raw material. Flow control, however, is only one phase of the need for three-element cascade control.

Analytical-instrument controllers . . . Undoubtedly one of the most important developments in the field of industrial instrumentation is the growing interest in analytical instruments. In spite of their widespread use, how-

(Continued on page 98)



TYPICAL CONTROL setup for instrumentation of a distillation column. Fig. 6.



CASCADE-CONTROL system for distillation column, using pneumatically set ratio relay. Fig. 7.

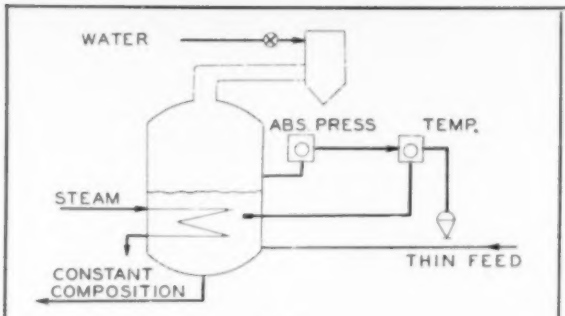


Fig. 1.

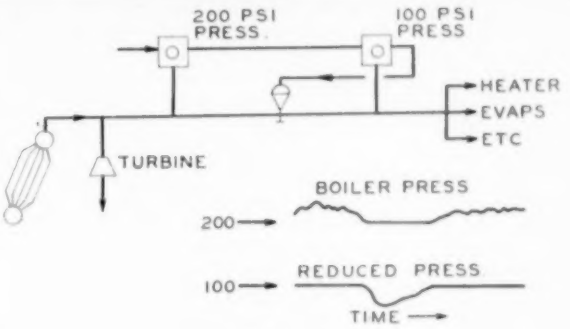


Fig. 2.

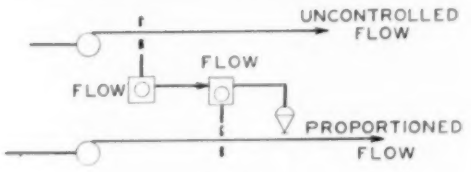


Fig. 3.

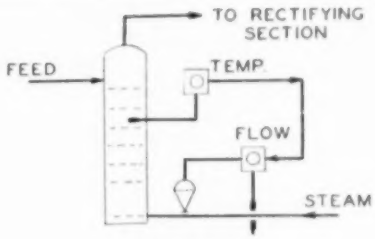


Fig. 4.

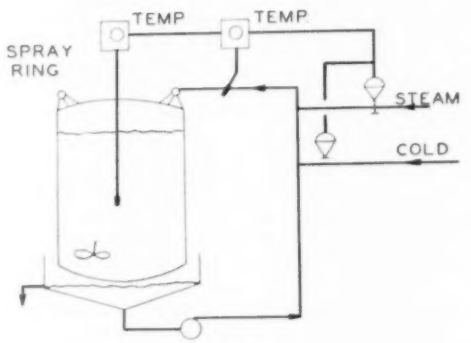


Fig. 5.

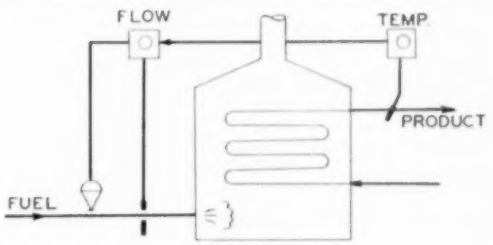


Fig. 6.

PROCESS INSTRUMENTATION

An Evaluation of Cascade Control Systems

Here are four reasons for their existence, ably discussed

by J. G. Ziegler

CASCADE control is not precisely defined but generally involves at least two controllers interconnected so that one varies the set point at which the other controls. Each measures a separate but related variable.

A piece of processing equipment may have more than one controller, but they do not necessarily constitute a cascade control system in the accepted sense. For example, the temperature of a solution boiling in an evaporator can be a significant measure of its concentration only if the absolute pressure is known.

One controller may manipulate the condenser to maintain a constant absolute pressure and another measuring temperature may regulate liquor feed to maintain constant composition of the solution within the evaporator. The two variables are related but this is not considered to be cascade control.

If, however, it were desirable to operate the evaporator at the lowest obtainable absolute pressure, maximum condenser water flow would be used even though the absolute pressure varied with evaporating rate and with condenser water temperature and supply pressure. Control of solution concentrate could still be controlled on a temperature basis if the absolute-pressure controller were arranged to vary the

Author is associated with Taylor Instrument Cos. San Francisco. Paper presented at ninth annual symposium on Instrumentation for the Process Industries, Texas A. & M. College, January 27-29, 1954.

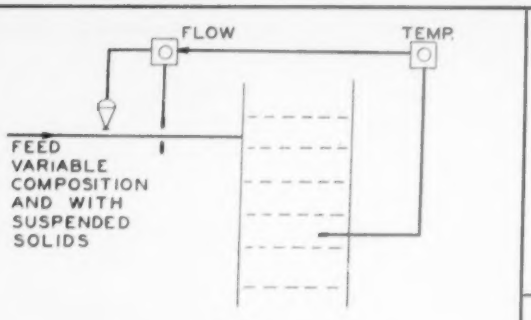


Fig. 7.

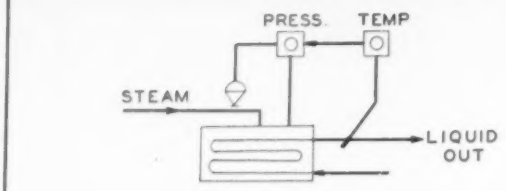


Fig. 8.

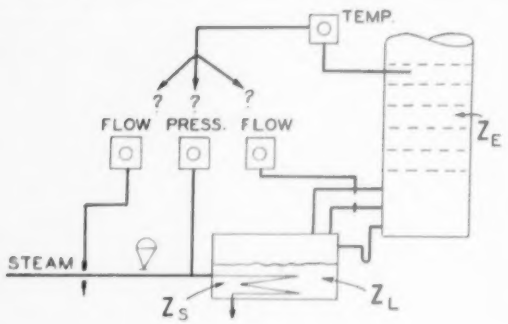


Fig. 9.

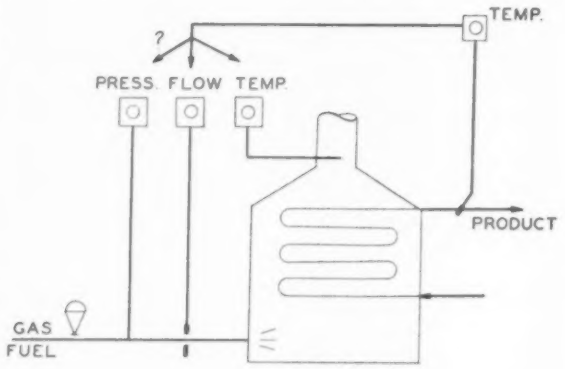


Fig. 10.

Process Instrumentation

set point of the temperature controller to maintain the required boiling point for each absolute pressure. This would be one type of cascade control system, Fig. 1.

Override systems . . . The use of two controllers and one valve does not necessarily indicate a cascade control system; it may be only a limiting "override." For example, a steam-reducing station supplies constant pressure to a series of users which may at times call for more steam than is being supplied by the boiler and, in dropping the high steam pressure, interferes with a more critical piece of equipment such as a turbine.

The controllers may be connected as shown in Fig. 2 so that either is able to reduce the control-valve opening; the outright pressure of one controller is the air supply pressure of the second. A sudden increase in steam flow which causes the main steam pressure to drop to the set point of its controller throttles the valve to maintain the value even though the reduced pressure falls. As soon as the boiler has picked up the increased load the reduced pressure returns to normal.

Why cascade systems . . . There seems to be four main reasons for the existence of cascade control systems. They may:

1. Maintain a desired relationship between variables.
2. Accurately limit a secondary variable.
3. Reduce load changes, nonlinearities, and discontinuities near their source.
4. Improve the control circuit to reduce effective time lag.

Examination of proposed cascade systems by placing them in one or more of the above classifications often discloses their futility or points up minor changes in instrumentation which can make major improvements in control results. Often a simple alternate selection of the secondary variable can make a system fulfill two or three of the above desired purposes instead of only one.

Systems for Purpose 1 are usually characterized by fact that variations in the secondary variable do not reflect back on the primary. Consider the process of Fig. 1 which is typical of this class of arbitrary set-point movement. The temperature (secondary) set point is positioned by the absolute pressure (primary) instrument to a predetermined pattern but variations in temperature do not alter the absolute pressure.

A similar system to that of Fig. 1 would be the maintenance of constant composition at some point in a column fracturing a binary mixture by changing a temperature set point from an absolute pressure measurement at the same plate.

Ratio flow . . . A very common example of these circuits is that of ratio flow, Fig. 3, where a secondary flow is held in some proportion to a primary uncontrolled flow. Ratio flow can be used to blend two or more fluid streams or it can regulate the heat flow to a fractionating column in proportion to a varying feed flow.

Another arbitrary set point change is found in the deaeration of fluids which are subjected to a reduced pressure sufficient to flash a small proportion of the liquid to vapor. The amount of flash is easily controlled by the fall in temperature of the fluid in passing through the deaerator so the incoming temperature sets the outgoing temperature a few degrees cooler and the controller regulates the vacuum source to maintain the temperature drop.

As a matter of fact a "time schedule" controller could be considered a cascade control system where the primary variable is Time.

Limiting secondary variable . . . Purpose 2 calls for cascade systems when some secondary variable can exceed the physical capabilities of the equipment or product.

Conventional bubble-plate fractionating columns have an upper limit of

vapor velocity beyond which entrainment becomes excessive or they inelegantly "puke." This same limitation applies to perforated plate columns and in addition they cease to operate below a minimum vapor velocity required to hold liquid on the plates. Consider a stripping column of the latter type in which live steam entering the bottom is regulated by the equilibrium temperature at some point in the column, Fig. 4.

By means of the steam flow controller it is possible to set definite limits on the vapor velocity in the column so that the temperature controller can never call for heat flow above or below the physical limitations of the particular column. A sudden surge of feed flow or its composition may cause a drop of temperature but steam flow will be set only up to the very maximum allowable. Likewise on feed failure the temperature will rise and the column slowly strip out under minimum steam flow. The cascade control system in this case allows maximum and minimum limits to be set more accurately than the application of stops on control valve travel.

Fig. 5 shows a reaction kettle which is heated or cooled by water circulating to a spray ring and over the outside. Steam or cold water is introduced to supply or withdraw heat from the kettle contents. A cascade control system is desirable if low water temperature can cause the product within the kettle to solidify on the inner wall or if the product is damaged by excessive temperature.

A fired heater such as that shown in Fig. 6 may have insufficient stack capacity to withdraw combustion gases above a definite maximum firing rate. A derivative response is desirable in the primary temperature controller but momentary load changes or disturbances could open the fuel valve beyond the upper limit of the furnace were it not for the secondary fuel flow controller which is adjusted so that its set point cannot be moved above the exact maximum which is tolerable.

This limit is not changed by fuel supply pressure to the control valve. The beneficial effects of the derivative response are retained except that product temperature recovers more slowly on increased load but this is to be preferred over blowing black smoke or bulging the breechings.

Load changes . . . Purpose 3 is justification for some cascade controls when a secondary controller is used to correct for a load change or discontinuity **at a point of favorable lag** compared to the primary controller of the cascade. At times several different load changes can be cleaned up by one secondary controller.

Returning to the fired heater of Fig. 6, the fuel flow controller can correct very quickly for changes in fuel supply pressure with a period of oscillation of a few seconds. Changes in product flow or incoming temperature must still be corrected by the outlet temperature controller with a period of oscillation of several minutes. Were it not for the secondary flow controller, fuel pressure-load changes would also have to be corrected by the temperature controller with the inevitable long period and large deviations. The fuel flow controller in this application has two purposes, 2 and 3.

The column of Fig. 7 is fed with a slurry which builds up in the control valve but clears when the valve is opened sufficiently. This occurs at random several times a minute. The feed composition varies widely and it is found that temperature held constant a few plates below the feed maintains good stripping conditions over the wide range of feed composition, increasing feed rate as it becomes less rich in low-boiling product and thus increasing capacity of the unit. But these few plates introduce a large lag in the temperature-control circuit giving a period of oscillation greater than the average interval between flow changes due to feed-valve plugging.

Stable control of temperature could not be obtained were it not for the secondary flow controller which maintains a good average feed flow since this secondary circuit has a very short time lag.

Another very typical example is found by substituting a reciprocating steam pump for the plugging slurry of Fig. 7 with the control valve on the steam supply to the pump. Operated below a narrow range of stroking rates, steam pumps tend to go "lame" and stop or race. On a critical column feed service such as this, the cascaded flow controller operating the pump throttle valve is highly desirable.

Not only load changes but discontinuities and nonlinearities of circuits should be considered under Purpose 3. A good example of a discontinuity is the friction in control valves which is normally reduced by the use of a "positioner." Interestingly enough a positioner is really a "pneumatic set" position controller and so is nothing more or less than a secondary controller in a cascade control circuit.

In the liquid heater of Fig. 8, the time constant associated with the tube-and-shell capacity is reduced by the secondary pressure controller. Pressure may be used in this case as an indication of tube-wall temperature since the liquid film offers a much greater resistance to heat transfer; the tubes will be practically at the temperature corresponding to steam pressure.

In gas compression, suction pressure operates the throttle valve of the engine driving a compressor. The inertia of the engine and compressor contributes the time constants causing the effective circuit lag but it can be reduced toward the vanishing point by a cascade system in which the primary suction pressure controller calls for the set point of a secondary controller measuring engine speed and operating the throttle valve.

Secondary variable choice . . . So often in cascade control applications a careful choice of the secondary variable can increase the number of circuit evils it reduces or eliminates. Fig. 9 poses a problem in this regard.

A bulb in the stripping section of a column can be connected to any of three secondary controllers measuring steam flow to the reboiler, steam pressure in the heating surface, or vapor flow to the column. The three time constants to be considered are those of column equilibrium Z_e, the heating surface Z_s, and the liquid in the reboiler Z_1, in descending order of magnitude. It can be assumed that proper application has reduced measuring lags to a negligible value.

The steam-flow controller could accomplish only one thing, the elimination of load changes from the steam supply pressure. If this pressure were nearly constant, the flow controller would have only decorative value.

Steam pressure, indicative of heating surface temperature, would not only correct for steam pressure changes but would reduce the time constant of the heating surfaces, the most important one since it is the second largest in the circuit.

Normally the time constant of the liquid side of the reboiler is small but a slight further improvement might be made by including it in the secondary circuit. Vapor flow is really the force which causes the temperature equilibrium to rise or fall in the column so this final choice comes the nearest to reducing the primary control to a single capacity system. In addition, load changes arising from conditions of the heating surface such as erratic venting and condensate removal would be cleaned up quickly by the vapor-flow controller and not by the primary-column temperature.

Vapor flow from reboiler to column is the most direct measure of vapor velocity in the column but either pres-

sure or temperature could be satisfactory at this point since the column itself acts as an orifice. Increase in vapor flow increases the pressure and consequently the temperature at the bottom of a column.

Lag reduction . . . In the application of cascade control for the purpose of lag reduction, care must be exercised not to include too many time constants in the secondary circuit else the effective lag and consequently the period of oscillation may approach the time constant of the primary variable. Every effort must be made to keep the period of oscillation of the secondary system short. If in the process of Fig. 9, the three time constants were of the same order of magnitude, a three-instrument cascade could be required; column temperature to reboiler vapor flow to heating surface pressure to valve.

The fired heater shown in Fig. 10 gives a choice of three secondary variables, fuel pressure, fuel flow, or combustion-space temperature. Fuel pressure to the burners is a measure of fuel flow due to the piping and burners acting as an orifice so it is immaterial whether pressure or flow is the secondary measurement. Either improves the control circuit by eliminating the effect of the fuel pressure changes (Purpose 3) and allows a maximum limit to be put on fuel flow to stay within the physical limitations of the combustion space (Purpose 2).

Stack temperature as the secondary variable would not only pick up variations in fuel pressure very quickly, but would catch changes in B.t.u. content of the fuel as well and eliminate this load change on the primary controller. It would also allow an upper limit to be put on temperature in the combustion space.

Other Articles on This Subject

"Process Lags in Automatic Control Circuits," J. G. Ziegler and W. B. Nichols, Trans. A.S.M.E., Vol. 65 (1943) 433-444.

"Valve Characteristics and Process Control," J. G. Ziegler and N. B. Nichols, Instruments, Vol. 22 (1949).

"Industrial Process Control," J. G. Ziegler and N. B. Nichols, Chem. Engn. Progress, Vol. 43 (1947) 309-314.

"Dynamic Accuracy in Temperature Measurement," J. G. Ziegler and N. B. Nichols, Instruments Vol. 23, (1950) pp. 66-69.

Some New Aspects of Cascade Control

(Continued from page 94)

ever, very few analytical instruments are employed as automatic controllers. Obviously the importance of the application on which these instruments are used is sufficient to justify the advantages of automatic control. Apparently the only deterrents to control from these instruments are technical difficulties.

There are very few applications where such an instrument can be used to operate a valve directly in a simple control loop. If a simple loop is impractical, some form of cascade arrangement is necessary. Actually it is a matter of rather general agreement that computers will be needed for this purpose.

Today's processes are controlled by groups of environmental instruments regulating temperature, pressure flow, and certain other variables in accordance with empirical data. Although most of the controllers operate simple loops, all of these variables are interrelated. Given a relatively constant composition of input and only minor variations in process efficiency, a uniform high-quality product is obtained. Process upsets, however, are not too infrequent and may result from several causes. Each upset yields off-quality product.

In order to minimize the effect of an upset, an analytical instrument may be employed to measure composition of an intermediate or final product. The signal from this instrument should initiate corrections upstream to compensate for the change which produced the upset. Because the upstream environmental controllers regulate related variables it would be quite seldom that correction could be made by adjusting the set point of any single instrument. In other words, conventional cascade control would not be flexible enough in most cases.

The pneumatic set relay, however, allows the interlocking of any two related variables or even more by successive cascading if it should be necessary.

HCl production . . . A common problem in the chemical industry is the manufacture of hydrochloric acid from hydrogen chloride and water. The hydrogen chloride from the burner and water are introduced into an absorption column. Often water is proportioned to gas by a ratio flow system because gas flow is not as steady as desired. This control system is not quite adequate because the purity of hydrogen chloride varies as burner efficiency changes.

It is possible to correct for fluctuations in supply and purity by the system illustrated in Fig. 4. The gas analyzer measures hydrogen chloride concentration and a signal proportional to the concentration is transmitted as input B to the relay. This signal adjusts the ratio to compensate for changing gas purity. In this system higher gas purity requires more water or an increased ratio so the output of the relay is direct.

This hydrochloric acid control system is an open loop. No means is provided for measuring concentration of the output acid. Of course, acid concentration could be measured as a check on the system or the ratio might even be set by an acid-strength controller. In this instance, however, the system described was selected to minimize measuring lag. It is quite obvious that here the relay is being used as a simple computer. Actually it calculates the flow of hydrogen chloride from total gas flow and gas composition.

Absorber control . . . Another operation frequently seen in the petroleum and petrochemical industries is hydrocarbon gas absorption. The usual control system for the absorption tower is an open-loop system and cannot compensate for changes in composition of wet-gas supply. Some means is needed to detect and correct for upsets.

The most convenient means for affecting correction is measurement of density of the rich oil. However, there is quite a time lag in density measurement and hence cascade control is advisable. In Fig. 5 a closed-loop system is shown. The density transmitter and the relay alter the ratio of lean oil to wet gas to produce a uniform rich oil regardless of supply conditions.

Fractionator control . . . One of the most complex problems is the control of distillation columns. Because of time constants, close relation of all variables, and sensitivity to very minor changes in any variable, most columns are difficult to maintain in stable operation. Fig. 6 shows a typical control setup.

In order to gain stability, cascade arrangements are commonly employed. Often both temperature and pressure are controlled by resetting flow controllers. Control of tower-top temperature by resetting reflux flow is also widely utilized. Even this array of controllers is not enough to insure stability in the face of upstream upsets.

The distillation control system illustrated in Fig. 7 is very similar to that in Fig. 6 except that it is more resistant to the effect of upsets. Any change in quantity of feed necessitates a corresponding change in reflux rate if tower upsets are to be avoided. Of course, a tower cannot be operated if feed is not quite constant, but occasional small changes are inevitable. Even these can have serious consequences if they are not noted in time. The cascade system shown does much to minimize this kind of trouble.

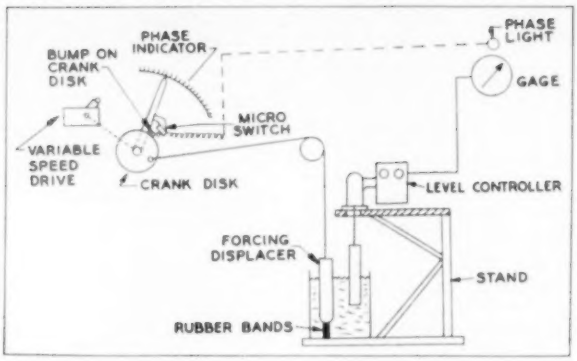


Fig. 1—Hydraulic sine wave generator for determining instrument response.

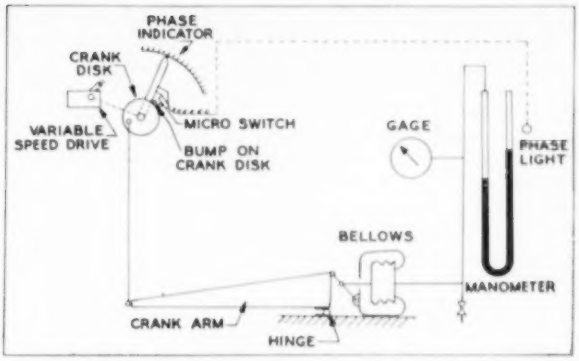


Fig. 2—Pneumatic sine wave generator for determining instrument response.

PROCESS INSTRUMENTATION

What the instrument engineer should know about

Evaluation of New Instruments

The dollar sign plays an important role and must be considered

by W. A. Crawford

ONE of the problems which continually plague an instrument engineer is that of evaluating new instruments and control devices. Evaluation is a basic part of the instrument engineer's everyday job. This is prompted by the fact that he works in a rapidly changing field of engineering. The industry which proffers the instruments and devices with which he works is one which realizes the need of remaining fluid in its production so that it can stay in business by producing equipment embodying the latest features of design and application.

The instrument engineer finds himself in a position where he must continually review new designs. Because of this he has become what might be called an inquisitive dreamer who must be ready to call on a broad variety of engineering knowledge to permit him to quickly compare many similar types of equipment, electronic, hydraulic, pneumatic, and mechanical. He must also determine which of these types is best suited to solve a multitude of general and specific problems for which the complete requirement may not always be known.

Engineering evaluations, must be based on sound engineering facts and not on opinions or appearances. On the other hand, the dollar sign plays a very important part in engineering evaluations. It is a factor which cannot be overlooked in selecting equipment, since the investment must be justified.

Instrumentation is evaluated for two primary reasons: **(1) to determine if new equipment can do an old job better than the old equipment, and (2) to determine what new jobs can be done by the new equipment that cannot be done by the old equipment.**

Evaluation of new equipment is a tool which the instrument engineer uses because of the importance of the job. He knows that plant conditions are seldom the same as test conditions. Armed with the manufacturer's data and literature he plans his evaluation program.

Design evaluation . . . In the du Pont company, instrument evaluations might be classified into six separate types. The first of these may be commonly considered as the quick and urgent type. This type is a literature search or design evaluation and is generally done by an applications engineer. The engineer simply acquires data in the form of manufacturers' reports and tests, blue prints showing cutaway views of the instrument and catalogs literature on the instrument.

If it is done by an experienced engineer, he will screen out many types of equipment before they are analyzed in detail and will save many hours of needless work in the laboratory or field at a later date. It is in this type of evaluation that good, sound engineering principles and experience will point out many things which may affect the value of the equipment to industrial application. This screening-out process is a must in any program designed to minimize the number of detailed evaluations so that maximum effort, both timewise and talentwise, can be put on the job to be done. In this type of evalu-

TABLE 1—INSTRUMENT EVALUATION —DESIGN TESTS

1. Does this equipment perform a duty that can't be done by other equipment?
2. What are the limitations of its application? Is the design flexible enough to be used for more than one application?
3. Does its size and weight limit its use? What are its space limitations?
4. Are the principles of its operation good? Are the friction forces expected to be small compared with the total working forces? Is it null balance?
5. Is its design conducive to corrosion-resistant construction?
6. Is it suitable for outdoor use?
7. Is it a rugged, simple design?
8. Is it easy to install?
9. Is it easy to maintain?
10. Are the expendable parts inexpensive?
11. Does it satisfy "code" and legal requirements for safe use?
12. How many of these units have been made?
13. How many of these units have been used?

Author associated with E. I. du Pont de Nemours & Co., Wilmington, Del. Paper presented at ninth annual symposium on Instrumentation for the Process Industries, Texas A. & M. College, January 27-29, 1954.

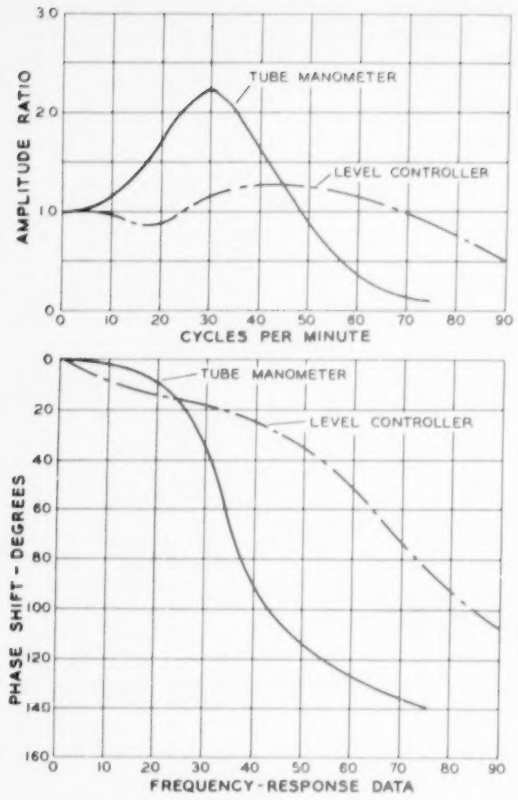


Fig. 3—Frequency response data obtained during instrument test.

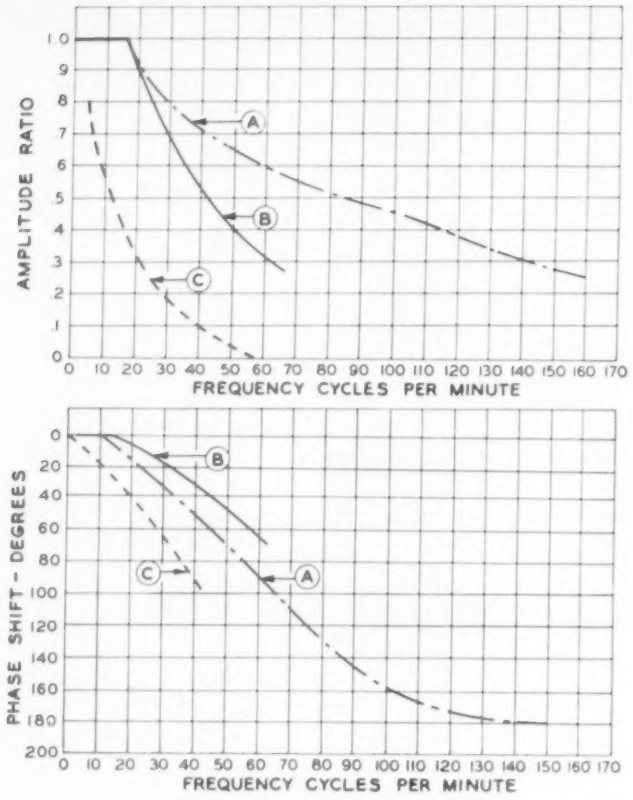


Fig. 4—Results of tests made on three valves, A, B, and C.

Process Instrumentation

tion a number of things are looked for. These are shown in Table 1.

Most of these questions can be answered to the satisfaction of an engineer if he reviews the manufacturer's drawings or cutaway sketches with a critical eye. At this time it is important that he be aware of the approximate price of the equipment as well.

Visual evaluation . . . The second type of evaluation is one which can be accomplished simultaneously with the first and should provide additional information to the engineer. This is a type of design evaluation. This is one wherein a visual inspection shows the engineer the additional points shown in Table 2.

TABLE 2—INSTRUMENT EVALUATION —VISUAL INSPECTION

1. Does it have good workmanship?
2. Are its assembly and disassembly simple? Can it be done by one man? Must he be skilled?
3. Are its visual features effective? Can it be easily read or interpreted?
4. Is its weight or mass of the moving parts so excessive that it may hinder rapid response?
5. Are all of the factors determined in the first evaluation still reasonable?

Quick shop test . . . The third type of evaluation which in reality supplements the second type is a quick shop test of the unit in operation which may prove several other pertinent points concerning its performance. These are shown in Table 3.

TABLE 3—INSTRUMENT EVALUATION —PERFORMANCE UNDER IDEAL CONDITIONS

1. Does the unit perform the duties it is expected to accomplish?
2. Is it sufficiently sensitive in its response to a small change in signals?
3. Is the range span correct?
4. Will it follow a rapidly changing signal?
5. Are there any mechanical or electrical weaknesses noted in its operation?
6. Does it produce absolute or relative values of measurement?
7. Is the unit tested a production-line unit or a model shop unit?

With this type of test the engineer can definitely decide whether the unit can be expected to perform satisfactorily when first installed. These tests represent performance under ideal operating conditions. However, plant operating conditions are seldom ideal in many respects, and further tests should be made on this equipment to point out weaknesses which may occur in actual operation.

Nonideal conditions . . . The fourth type of evaluation is, therefore, a more detailed one and one which may take weeks or months rather than days to complete. It is a test which will be more expensive to make, yet may be required to prove whether units of this design can be expected to perform satisfactorily in actual operation. The importance and extent of the application

TABLE 4—INSTRUMENT EVALUATION —PERFORMANCE UNDER NON-IDEAL CONDITIONS

1. As-received calibration.
2. Power-supply fluctuation error. This may be air-supply pressure fluctuations or electric-power-supply voltage fluctuations.
3. Power-supply consumption.
4. Effect of ambient-temperature change.
5. Effect of barometric pressure change.
6. Effect of vibration on performance.
7. Effect of case distortion or distortion by piping connections.
8. Hysteresis found in calibration.
9. Dead spot found in calibration.
10. Any indication of drift when operating with input constant for a period of time.
11. Effect of overranging input.
12. Life expectancy tests where necessary. Does fatigue occur during life expectancy tests?
13. Effect of rapid variation of input or frequency response test.
14. Other tests where necessary; i.e. destruction tests for corrosion, strength of materials, erosion, etc.

under consideration will determine whether such a test should be made. In this type of evaluation, which is in effect a performance evaluation, the things that are looked for are shown in Table 4.

Plant tests . . . Complete tests of this sort are about as far as laboratory analysis can go to point out the ability of the new unit to operate satisfactorily under actual plant conditions. The next step is to install several units in actual plant operation. For this type of test it is recommended that the application chosen be one which is expected to prove the worth of the equipment. If possible, it should be one which would require maximum performance provided safe operation is not jeopardized. The test should be followed by a competent engineer and a full record of results should be kept. From a plant test, answers to the questions shown in Table 5 can be expected.

TABLE 5—INSTRUMENT EVALUATION —PLANT TEST

1. Does it satisfy the application requirement?
2. Does it perform in actual installation under nonideal conditions—dirty air supply, freezing weather, etc.?
3. Does it drift periodically? Why?
4. Does piping strain affect it?
5. Can it be calibrated, adjusted, maintained, etc. easily?
6. Last but not least, is it reliable?

Plant service . . . The final evaluation to be given to equipment is that of installing many units in plant service. Many people feel that this period of operation can no longer be considered in the category of a test. However, there are still many factors that should be determined before the unit can be rightfully considered suitable for unlimited service. It is only in plant operation of a large number of units that information of this sort can be obtained. This phase you might call the "proof of the pudding" phase. A follow-up on its performance should include the questions shown in Table 6.

TABLE 6—INSTRUMENT EVALUATION —PLANT USE

1. Can inexperienced men maintain it?
2. Does it satisfy a wide range of applications?
3. Does it perform as expected under these various applications?
4. Are the maintenance costs high?
5. Is it reliable?

These are the various types of evaluations which du Pont performs on instruments. The evaluations are sequenced in the order which they normally would be carried out. A true and proper evaluation should go through the first five steps before the sixth one is attempted but in many cases this it not followed. The Type 1, design evaluaton, is always followed. This is always the first step which an instruments application engineer takes in analyzing new equipment.

Type 2 evaluation, visual, generally follows the Type 1 evaluation. Type 3 evaluation, performance, is generally accomplished prior to the purchasing of any equipment. The Type 4 evaluation, because it involves long periods of time, is one which is applied only where necessary because of the potential importance of this type of instrument to the company. The Type 5 evaluation, a plant operating test, generally follows for most types of equipment. This evaluation confirms many answers that the performance evaluation, the Type 3, indicates.

There have been many cases where, because of the urgency of the requirement, plant testing followed design and visual evaluations, completely bypassing the Type 3 and Type 4 evaluations. There have been few cases where all five steps have been followed sequentially prior to a large plant installation.

Testing groups . . . These evaluations are done by many independent groups. The engineering department has five groups of engineers interested in instrumentation. In the design division, engineers specify and procure instrumentation for new facilities and major expansions of existing facilities. Engineering service division engineers serve as consultants to the industrial departments and propose many improvements directly to the plants.

The development engineering division operates two laboratories, the engineering research lab and the mechanical development lab. Both laboratories are interested in the development of new types of instruments and control devices. The construction division also is definitely interested in new equipment. In the engineering department, design and performance evaluations of Types 1, 2, and 3 are normally initiated and sponsored by design and engineering service divisions.

The research lab and mechanical development lab participate in performing the Type 4, nonideal performance evaluations. They may also make design and ideal-performance evaluations of equipment they use and the equipment they develop which may have general value to the company. The construction division has aided in several cases in accomplishing the performance evaluations noted as Type 3.

At the plants, the industrial departments have several independent groups interested in evaluation of new instruments. Generally, each plant instrument-maintenance group has taken quite an interest in evaluations. In addition to this, in most plants, the plant technical groups are also interested in evaluations. Plant maintenance groups have performed all types of evaluations on equipment where the data obtained are of vital importance to the operation. Plant technical groups have participated in many phases of these evaluations also and have in some cases made particular contributions to the complete laboratory type of evaluation.

Within the engineering department there is another group that plays an important part in the final performance of equipment. Data taken from equipment evaluations have helped to determine the standards of quality that can be expected in performance of equipment. As part of procurement specifications for new equipment, the vendor supplying this new equipment must guarantee that it will perform in accordance with these standards of quality. The inspection section in the construction division plays an important part in witnessing vendors' tests to be sure that equipment, prior to shipment, meets these requirements. Vendors in many cases are asked to test their own equipment in the presence of du Pont's inspector to assure that it will satisfy the performance guarantees on which the vendor and the company have agreed in the purchase order.

Specific Tests

One of the more specific aspects included in evaluations is the ability of the instrument to follow a changing signal. In the Type 3 test it is important to be able to determine the relative merits of equipment with respect to frequency response, provided the tests can be made quickly and cheaply. In most cases, results of frequency response tests tell more about the application than about the instrument.

The equipment, for this type test, was developed for training engineers to show them the effect of variations in input. Fig. 1 shows the equipment set up to change the water level in a vessel according to a time pattern by raising or lowering a displacer.

The displacer of a level transmitter under test is also mounted in this vessel. The output of the level transmitter is visually noted and (as it reaches a maximum or a minimum) the level arm at the lever arm disk is adjusted until the output light flashes simultaneously with the maximum or minimum transmitter output. This orientation around the center of the crank disk

(Continued on page 119)

When Drilling Rigs Put Out to Sea . . .

. . . It's the completely mobile units that get the nod

by John M. Payne

INITIALLY, offshore drilling operations were carried on from large self-contained platforms with well costs amounting to as much as tenfold that of conventional land drilling. But the problem of drilling the several exploratory wells which often are required to locate and define the productive area of a single field did not lend itself to such practices.

Although multiple-well platforms afforded some cost reductions, it was soon realized that development of mobility in offshore drilling equipment would be desirable in a large majority of cases. This led to the use of small drilling structures complemented by floating drilling tenders which serve as supply boat and crew quarters and hold most of the drilling equipment except derrick, hoist, and possible standby mud pump. This technique and modifications thereof have been utilized in drilling a large majority of the offshore wells to date.

Completely mobile units, as the next step in reducing costs, offer a number of interesting possibilities. For several years, operators, contractors, and designers have recognized the advantage which might be derived from the use of such equipment; however, with the exception of one shallow water unit, little, if any, tangible evidence has been produced.

Mobile units should require little, if any, fixed structure; they should be capable of being moved under average weather conditions; be rigged up and drilling in a short time; be unaffected by poor soil conditions; and be able to withstand reasonable wind and wave forces without jeopardizing or interrupting operations. Although these conditions would appear to be relatively simple, units meeting these qualifications will not be developed overnight and can be produced only after the most careful analysis is made of all the factors involved, using the best technical knowledge available. In many cases, it will be desirable to augment the theoretical work with elaborate tests and special experimental analysis.

Mobile-Unit Characteristics

In order to determine the trends and thinking regarding mobile units, a questionnaire was prepared and circulated to 18 oil companies and 10 designers and contractors who are pursuing this problem. All of the operators active in offshore work indicated definite interest in mobile equipment, with many of them making serious plans toward procuring one or more units.

Shallow-Water Units

In the shallow-water range the fixed-leg submersible barge appeared to be the predominant choice. The desirable characteristics regarding this type of unit as indicated by this query are as follows:

1. Operating depths	10 to 40 ft.
2. Foundation support	Hull resting on bottom.
3. Classification of unit	Self-contained type.
4. Quarters required	For about 30 men.
5. Total plan area of unit	15,000 to 20,000 sq. ft.
6. Size drilling rig	Heavy duty (15,000-ft. rating).
7. Design limitations	100 m.p.h. maximum wind velocity. 20-year wave probability. 25-30-ft. clearance of unit above mean gulf level. 400 lb. per sq. ft. soil-bearing capacity. Bottom scour considered important. Maximum design stress of steel, 60 per cent of yield.
8. Portability	Move to adjacent locations in 1 day. Unit be towed at 3 m.p.h. against 4-ft. wave.
9. Operating limitations	Restricted operations during hurricane season. Able to operate 1 week without outside supplies.
10. Application of unit	To be used for all type wells (development as well as exploratory).

The answers by no means reflected complete accord and such items as clearance of unit above mean gulf level, wave probability, and effect of bottom scour showed wide divergence of opinion. The fixed-leg barge which floats to a drilling site is severely limited as to maximum water depth because of the high center of gravity of the unit with its drilling equipment mounted on the upper deck. One designer has avoided this by placing the pumps and prime movers in the lower hull. The stability during raising and lowering operating also becomes a major problem in deeper water.

Deep-Water Units

The majority of the operators were interested in deep-water mobile units, and various types of construction were indicated, including several designs which have not been divulged. Both elevating barges and mobile platforms played important parts in the considerations. The desirable characteristics predominating in the answers were as follows:

1. Operating depths	15 to 100 ft.
2. Foundation support	All types, i.e., piles, hulls and combination thereof and other supports not mentioned.
3. Classification of unit	Self-contained type (excluding two companies who have several tenders).
4. Quarters required	For 30 to 50 men.
5. Total plan area of unit	20,000 sq. ft.
6. Size drilling rig	Heavy duty (15,000-ft. rating).
7. Design limitations	125 m.p.h. maximum wind velocity. 50-year wave probability. 40 ft. or more clearance of unit above mean gulf level. 400 lb. per sq. ft. soil-bearing capacity. Importance of scour—questionable. Maximum design stress of steel, opinions equally divided between 60, 80, and 100 per cent of yield.
8. Portability	Move to adjacent locations in 3 days. Tow unit at 5 m.p.h. in 5-ft. waves.
9. Operating limitations	Unrestricted, year-around operations. Operate 1 to 2 weeks without outside supplies.
10. Application of unit	To be used for all type wells (development as well as exploratory).

The questionnaires indicated a fairly wide range of operating water depths which may or may not prove desirable. In shallow water the total daily expenses of a unit capable of operating in 100 ft. of water may not be commensurate with sound economy, and a mobile unit designed for a narrow range should cost less and be easier to handle. However, wide depth application of the equipment is necessary if the volume of work in any given depth of water is insufficient to keep the unit employed. One limiting design feature in the type units discussed above is the slenderness ratio of columns or legs which become critical at the maximum depth rating of equipment.

Other Considerations

Besides first costs, operating and maintenance expense, additional consideration entering into the selection of mobile equipment in lieu of other drilling methods might be summarized as follows:

1. **Exploratory drilling**—The mobile unit is an ideal exploration tool and dry-hole costs should be reduced materially, since expensive fixed platforms are not required.

2. **Development drilling**—Experience should soon prove how useful this type equipment may be in drilling in a proven field. The application of single well-head-protection platforms or the development of submerged well-head completions offers considerable potentialities in this direction. Permanent-type well completions fit this approach very nicely. Also, installation of central production facilities to handle a large productive area may augment this type of program. It is entirely possible that every field will require a different approach and the selection of the best drilling and completion method will depend on a careful economic study being made in each field early in its development stages.

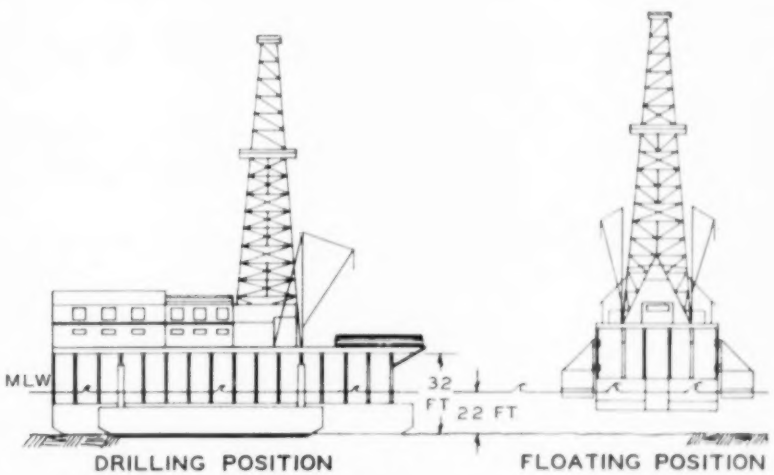
3. **Weather factor**—When bad weather is experienced offshore, drilling tenders must pull away from fixed platforms until the waves subside. This amounts to shutting the rig down as much as 10 per cent when allowing for time involved in preparing to shut down and in getting started again. Mobile rigs should be capable of continuous operations during this weather.

4. **Single-well completions**—The use of mobile units lend themselves to single-well completions, whereas several wells are often drilled from a single fixed platform to defray the cost of structure. The risk of having blowouts and fires offshore is always present and single-well installations reduce the hazard involved.

THE AUTHOR

John Payne is associated with Shell Oil Co., in Houston. He is chairman of the Southwestern District Committee on Drilling Practices for the American Petroleum Institute, and presented the accompanying article as a paper at that group's spring meeting in Houston last month. Payne is a native of Texas, and obtained his B.S. in petroleum engineering from University of Texas in 1941. Prior to joining Shell in 1944, he worked as equipment engineer for Black, Sivalls & Bryson, Inc., and as petroleum products expediter for the War Department.

Here are seven units operating or under construction



SUBMERSIBLE BARGE used by Kerr-McGhee in 10 to 22 ft. of water. Fig. 1.

To convey a clear picture of a few of the numerous mobile units which have been designed, a series of diagrammatic sketches have been prepared depicting several types of units which either are being constructed or are under serious consideration. Many other ideas for doing this job have been offered to the industry; however, the brevity of this paper does not permit their inclusion.

For simplicity in making comparisons of the equipment and techniques, the mobile units to be discussed have been grouped into the following three major categories:

SUBMERSIBLE BARGES—(Units having fixed legs and a floating hull which is sunk to rest on bottom):

1. Kerr-McGee.
2. Ocean Drilling & Exploration Co.
3. Southern Production Co.

MOBILE PLATFORMS—(Units having an elevated deck maintained at a given height above the water by means of extendable legs or columns):

4. Bethlehem.

ELEVATING BARGES—(Units having a floating hull which is lifted out of the water on extendable legs or columns):

5. Friede & Goldman.
6. LeTourneau.
7. Offshore Drilling Co., Inc.

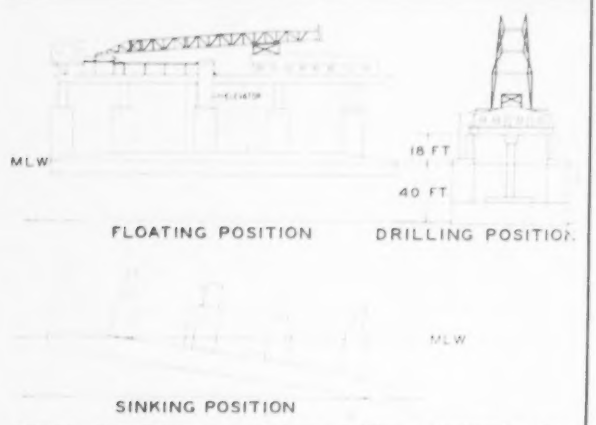
Up to now, the only offshore mobile unit in use is the Kerr-McGee barge (Fig. 1) which has operated in 15 to 20 ft. of open water and in slightly deeper water on semiprotected locations. This unit is the original Hayward-Barnsdall barge which has been in use for 5 years and has been very successful in shallow-water operations.

In one 5-month period it drilled 132,500 ft. of hole in an extensive strat-hole program.

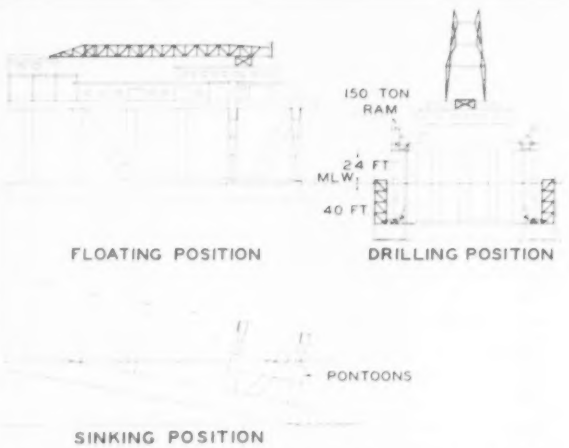
Other units of this class, either under construction or definitely planned, are shown as Figs. 2 and 3.

A unit of the mobile platform type, which is in the process of fabrication, is the Bethlehem which is shown as Fig. 4.

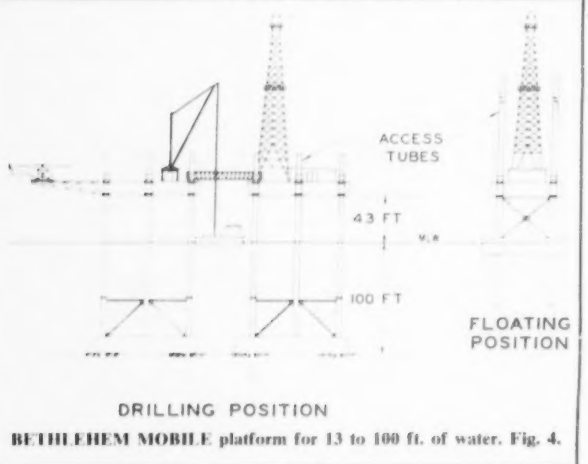
In the elevating barge class, three designs are given in Figs. 5, 6, and 7.



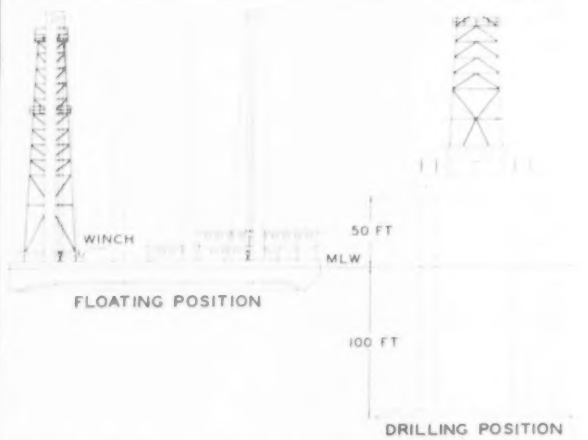
DIESEL ELECTRIC barge of Ocean Drilling & Exploration Co. Fig. 2.



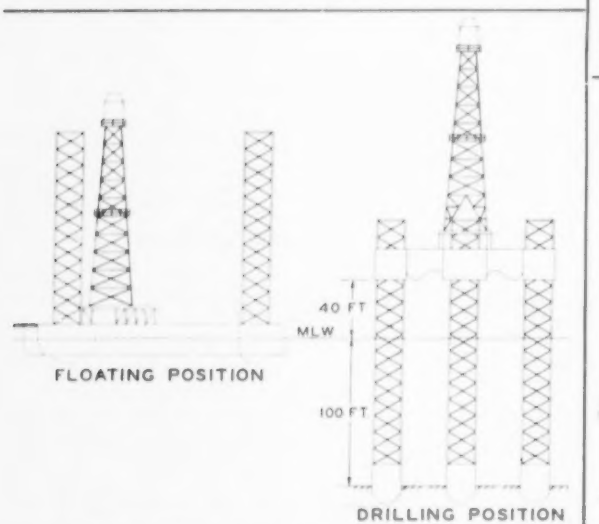
DIESEL ELECTRIC barge of Southern Production Co. Fig. 3.



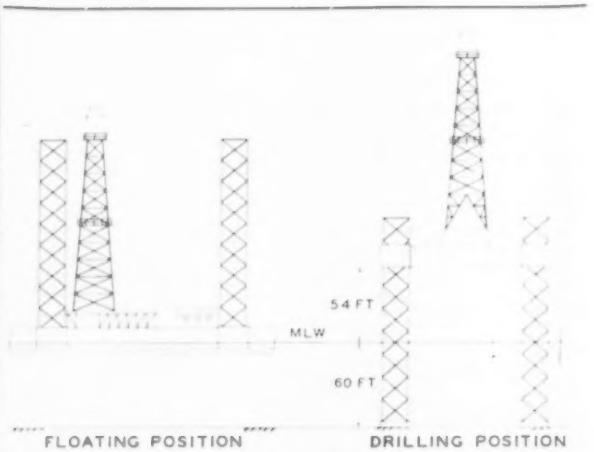
BETHLEHEM MOBILE platform for 13 to 100 ft. of water. Fig. 4.



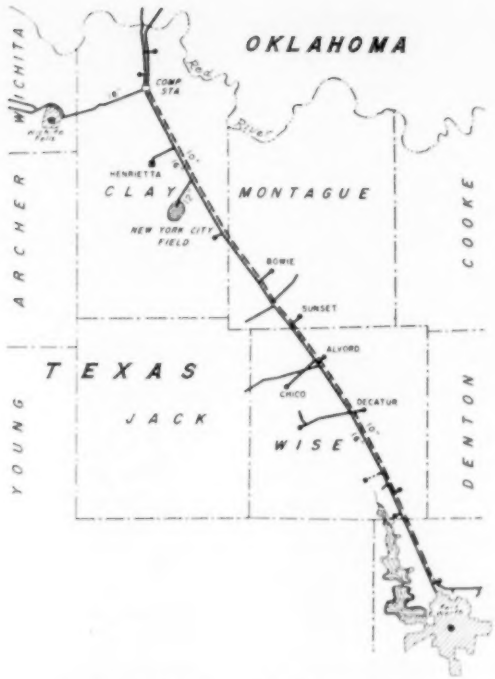
MOBILE BARGE of Friede & Goldman, for 20 to 100 ft. of water. Fig. 5.



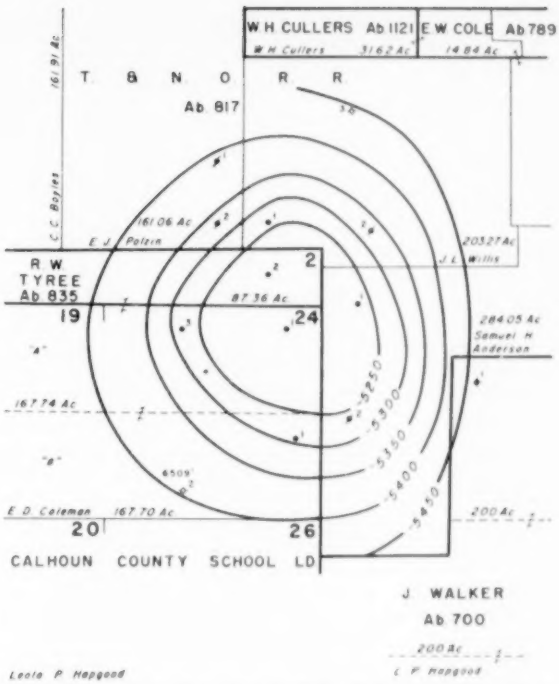
ELEVATED BARGE of LeTourneau Co., for up to 100 ft. of water. Fig. 6.



ELEVATED BARGE of Offshore Drilling, for 10 to 60 ft. of water. Fig. 7.



The field selected for storage was just 5 miles from one of the major gas-transmission lines of the company. The reservoir appeared to be completely closed, offering little possibility for loss of gas through leakage.



Structure map of New York City field. It was estimated that 6 billion cubic feet of gas could be stored in the reservoir at a pressure of 3,200 psig. Residual-oil saturation at time of abandonment in August 1950 was 49 per cent.

GAS STORAGE—A New Use for A Depleted Oil Field

. . . a case history of a successful project

by William F. Burke and T. W. Clay

A RAPIDLY growing market for natural gas and development of major new sources of casing-head gas in the operating area of Lone Star Gas Co., prompted company personnel to investigate the feasibility of underground gas storage near the company's central market area. The comparatively short duration of the winter heating season appeared to favor the storage of gas at pressures considerably higher than the operating pressure of the gas transmission lines in the area, and it was reasoned that a portion of the expense of the operation might be defrayed by storing gas at relatively high pressures in a depleted oil reservoir and utilizing some of the energy thus expended for producing oil.

Authors are with Lone Star Gas Co., Dallas. Paper presented at spring meeting of American Gas Association, Operating Section, conference of gas supply, transmission and storage.

The reservoir characteristics of the abandoned New York City Mississippian lime field, located in Clay County, Texas, appeared to be particularly adapted to these conditions and a gas-storage operation was initiated in this field during 1953. It was necessary to redrill or replug all the abandoned wells in the reservoir. Two of the wells were redrilled for injection wells and four were redrilled for use as oil producing wells.

As of January 1, 1954, a total of approximately 1,950,000 M.c.f. of gas had been injected into the reservoir and approximately 200,000 M.c.f. had been withdrawn, resulting in an increase in reservoir pressure from 130 psig. to approximately 1,000 psig.

Compressors were designed to store gas to a maximum reservoir pressure of 3,200 psig. and it is planned that future gas storage operations will be conducted within the reservoir-pressure range of 1,000 to 3,200 psig. The net storage capacity of the reservoir between these pressures has been calculated to be approximately 4,000,000 M.c.f.

The utility of the field as a gas-storage reservoir has been demonstrated by operation to date and it appears that the deliverability will be well in excess of the foreseeable requirements. As no oil-production history under this type operation is available, it is difficult to predict the future performance

of the field from the standpoint of oil production. A detailed study of the producing characteristics of the field under primary production has been made and this study together with the limited data available from the operation of the field to date lead to the conclusion that secondary oil recovery might be substantial.

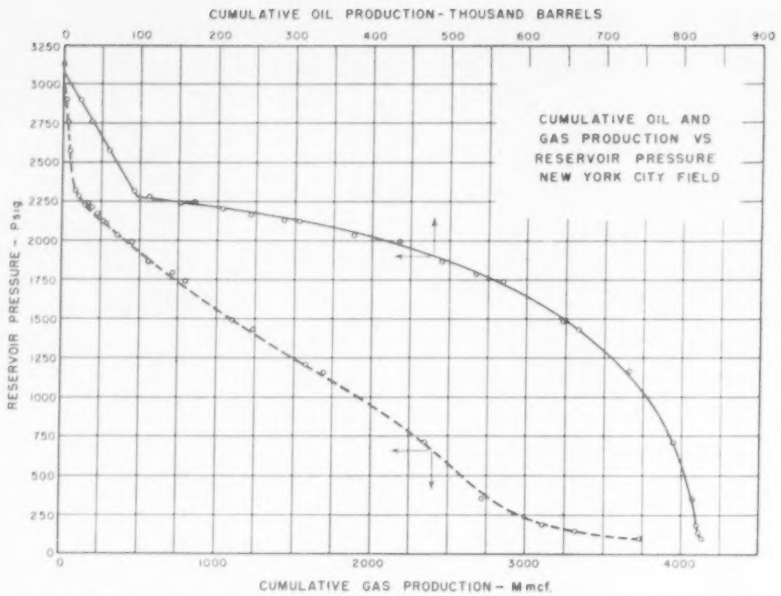
Reservoir . . . Connate water 23 per cent; residual oil saturation 49 per cent at time of abandonment, August 1950. The Mississippi lime reef reservoir volume initially occupied by oil was calculated to be 9.6 million barrels and the stock tank oil initially in place was estimated to be approximately 5.9 million barrels. It was estimated that 6 billion cubic feet of gas could be stored in the reservoir at a pressure of 3,200 psig.

Gas Injection Facilities

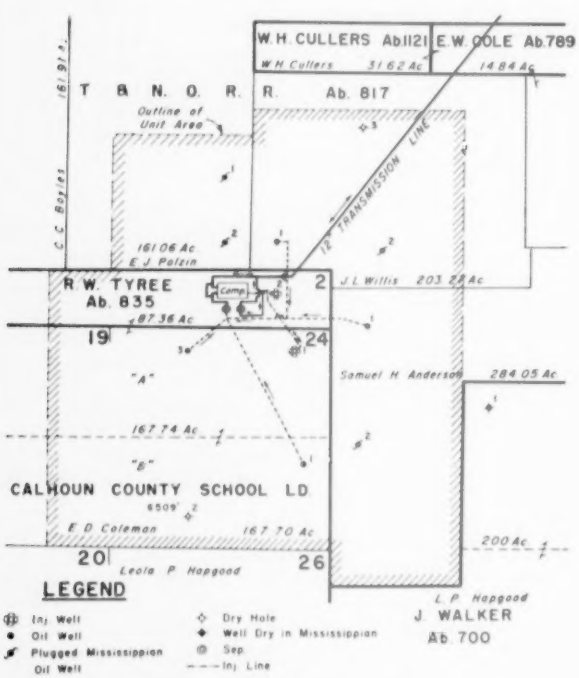
From a review of the producing capacities of the wells, it appeared that desirable gas-delivery rates could be maintained from a minimum of two wells down to a reservoir pressure of approximately 1,000 psig. With this in mind, two wells located in the central area of the field were selected for injection wells. It was calculated that approximately 2 billion cubic feet of gas would be required as a cushion to maintain the reservoir pressure at 1,000 psig. and that the effective storage capacity of the reservoir between 1,000 and 3,200 psig. would be approximately 4 billion cubic feet of gas. The top storage pressure of 3,200 psig., although slightly greater than the initial pressure, appeared to be well below the maximum safe operating pressure of the reservoir.

Using these factors, a compressor station was designed to inject an average of 20,000 M.c.f. per day at discharge pressures ranging from 1,200 to 3,200 psig. The compressor station consists of three Cooper-Bessemer (G.M.V.) type gas engines with a rating of 880 hp. each. Compression is accomplished in two stages from a suction pressure of approximately 300 psig. The theoretical capacity of the station is 24,720 M.c.f. per day at a discharge pressure of 1,200 psig. and is 17,400 M.c.f. per day at a discharge pressure of 3,200 psig.

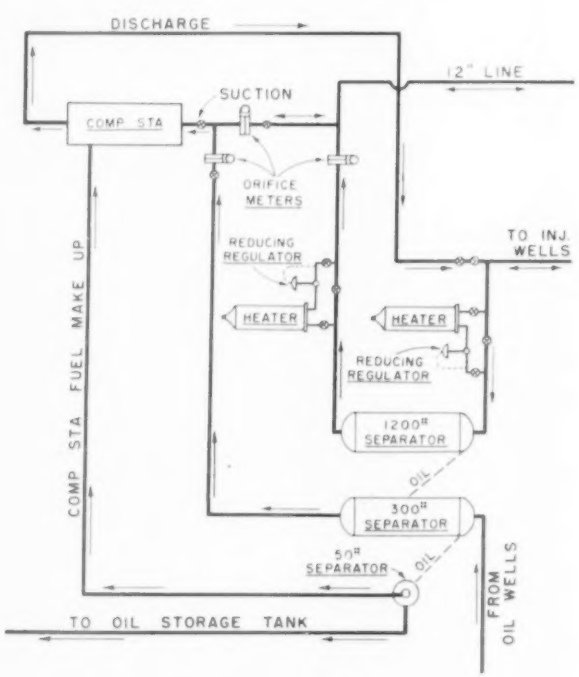
Four wells were redrilled and recompleted in the fringe area of the reef



Stock-tank oil originally produced had a gravity of 47° A.P.I. Initial reservoir pressure was 3,120 psig.



Field lines in New York City field.



Flow diagram of station.

NATURAL-GAS STORAGE PANEL . . . This group of experts headed a panel discussion at the New Orleans meeting of the American Gas Association on underground storage. The men are: M. V. Burlingame, Natural Gas Pipeline Co. of America, Chicago; C. W. Studt, Union Gas System, Inc., Independence, Kans.; J. V. Goodman, Equitable Gas Co., Pittsburgh, (presiding); C. C. Ingram, Oklahoma Natural Gas Co., Tulsa; Lysle R. Kirk, Ohio Fuel Gas Co., Columbus; John B. Corrin, Jr., Hope Natural Gas Co., Clarksburg, W. Va.

around the central injection wells. These wells were designed primarily for producing hydrocarbon liquids and were connected to both the suction of the compressor station and to the transmission line. Separators, heaters, and a tank battery were installed near the compressor site. A separator with a working pressure of 1,200 psig., and a large-capacity heater were installed on the gas-return lines from the injection wells. In this connection, the injection wells will serve as the principal source of gas during periods when large withdrawal rates are required. Separators designed for operation at 300 to 400 psig. and 50 psig. were installed on the line from the fringe wells. The low-stage separator is connected to the compressor fuel system and it is contemplated that all gas produced from these wells will be returned to the reservoir, delivered to the transmission line, or consumed as fuel.

Reconditioning of Wells

When the field was acquired, all but one well had been plugged and abandoned. Records outlining the plugging operations, amount of casing pulled from the wells, and location of plugs as well as other information necessary to study the condition of the abandoned holes were obtained from the former operator. Although the wells appeared to have been plugged adequately for normal circumstances, it was decided that every well which had penetrated a permeable section of the reef should be cleaned out and replugged as a protective measure against the proposed high pressure to which reservoir was to be subjected.

A few barrels of oil per day were being pumped from the Caddo formation above the reef in the well which had not been abandoned. This well had been completed originally in the reef and was one of the two wells scheduled for use as an injection well. The casing perforations opposite the Caddo formation were squeeze-cemented and the cement and gravel plug opposite the Mississippian reef was drilled out with cable tools. The well was completed originally from approximately 150 ft. of open hole with the casing cemented near the top of the reef. After recompletion, a production test revealed that the well produced no oil but a substantial volume of low-pressure gas. Gas production from this well was used for drilling fuel until the completion of a 5-mile pipe line connecting the field to the nearby transmission line.

A number of difficult problems were encountered in cleaning out the old wells. Ten of the 11 wells with permeable sections in the reef were drilled by one operator and a slim-hole drilling program had been used on all these wells. This program consisted of drilling a 6¾-in. hole and using a 5-in. o.d. producing string of casing. When the wells were plugged the casing was shot with nitroglycerin with the first shot being placed at approximately 5,000 ft. If the casing could not be pulled, then shots were placed successively higher until the casing came free. This resulted in a number of the wells being shot five or more times before the casing was successfully pulled. Unfortunately a number of these shots were not recorded and this, together with the condition of the pipe opposite the shot points, accounted for a large part of the difficulties in redrilling the wells. Also, as might be expected in abandoned wells, numerous articles of junk were encountered and a great deal of time was spent in fishing operations.

After replugging the wells designed for use in the project, the holes were deviated beginning in each case at a point above the top of the portion of the original producing string of casing remaining in the hole and new holes were drilled from those points into the reef. A considerable saving was realized by drilling these side-tracked holes instead of drilling new holes from the surface. In recompleting the wells, 5½-in. o.d. casing was cemented into the reef and perforated opposite the permeable sections. Wells designed for producing oil were equipped with a string of 2-in. tubing and the injection wells were completed without the use of tubing as it was anticipated that relatively little liquid would ever be produced from these wells.

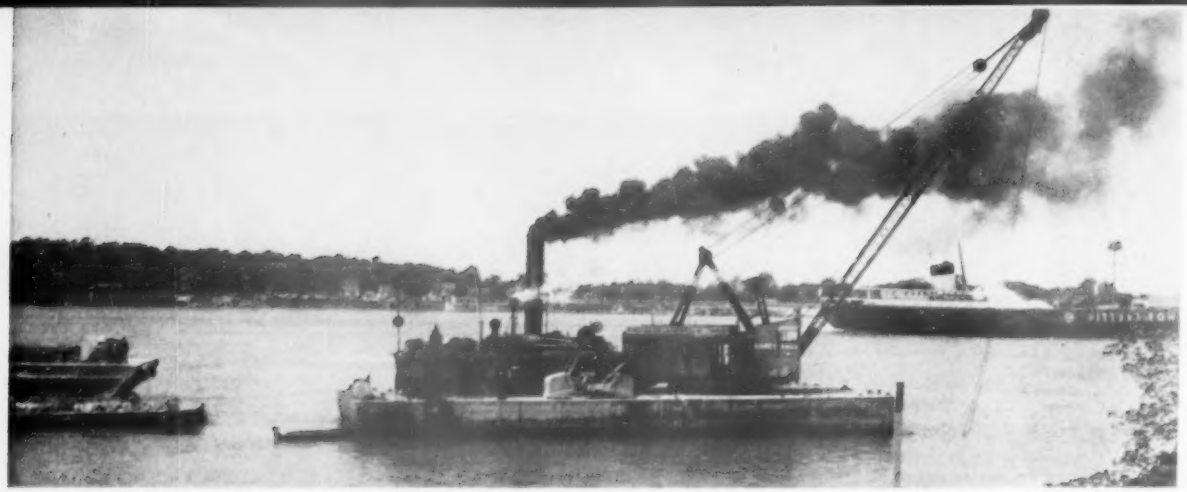
As of the date of this report, rework operations were complete on nine wells, two of which had been redrilled as injection wells, four of which had been redrilled as liquid producing wells, and three of which had been replugged. Replugging operations are under way on the two remaining wells and it is anticipated that this work will be completed within a short time.

Operation of Field

Gas injection into one well was begun in August 1953, prior to the completion of the compressor station. Tests indicated that the reservoir pressure immediately prior to injection was approximately 130 psig. and initial injection was begun from the pipe line at a pressure of 285 psig. without compression. Initial rate of injection at this pressure was approximately 9,200 M.c.f. of gas per day. The compressor station was completed shortly thereafter and as of this date a net volume of 1,750,000 M.c.f. has been injected into the reservoir. Most of this gas was injected prior to December 1, 1953. Gas has been withdrawn on several occasions from the two injection wells at rates up to 45,000 M.c.f. per day and it is estimated that the present deliverability from the two wells is approximately 60,000 M.c.f. per day against a pipe-line pressure of 400 psig.

Reservoir-pressure surveys were conducted in November 1953 and the average pressure was 1,000 psig. with a net volume of 1,700,000 M.c.f. of gas in storage. Very little variation in pressure from well to well has been noted. Production tests were conducted recently

(Continued on page 119)



DREDGING FOR TRENCH close to the Canadian shore. During pulling operations, one of the two winches was on this derrick barge anchored near the American shore.

Steep Banks, Deep Water, Heavy Traffic...

. . . But pipe was pulled as a single concrete-jacketed section in one day

by Paul Reed
Pipeline Editor

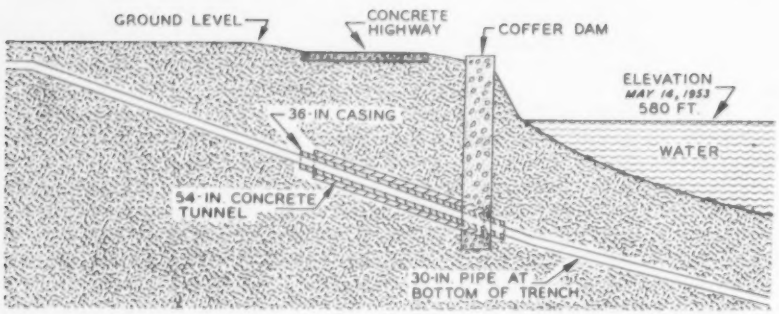


DIAGRAM OF CONSTRUCTION at the American shore. On both the American and Canadian shores of the St. Clair River the existence of concrete highways near the banks required tunneling which was facilitated by the sinking of cofferdam shafts.

A COMPLICATED set of problems was presented to constructors of the St. Clair River crossing between Marysville, near Port Huron, Mich., and Sarnia, Ont.—at the extreme eastern end of Lakehead Pipe Line Co.'s 645-mile, 30-in. crude-oil line from Superior, Wis.

Banks are high and steep, the water is deep, and the river is the busiest thoroughfare in the world for waterborne traffic. By carrying out a plan which involved effective use of cofferdams, tunnels, and special types of dollies with airplane landing wheels, the 2,020-ft. crossing was pulled in a single section in one day on July 22 last year.

Problem . . . Installation of a 30-in. pipe line at the St. Clair River presented the problem of laying across a navigated waterway which is 2,020 ft. from water's edge to water's edge with a maximum depth of 44 ft. from the water surface to the river bottom. Banks rise steeply at both shores to 15 to 20 ft. above the water level. Concrete highways close to the tops of the banks prevented usual type of bank cutting. It was important that the line be laid without interrupting ships which passed on an average of one every 7 minutes. Current in the river was swift, running at the rate of 6 m.p.h.

Solution . . . Pipe of 30-in. diameter, ½-in. wall, was pulled as a single 2,400-ft. concrete-jacketed section in one day. The pipe with concrete had a negative buoyancy of 30 lb. per ft. No pontoons were used in the pulling operation.

In preparation for pulling, large shafts were sunk near the edge of each bank to facilitate building of concrete tunnels below the water level to hold casing and pipe. When the line was finally installed, it was found to be within .1 ft. of estimated position at each bank.

Carrying Out the Project

Cofferdam shafts . . . To provide ready access to the working space in digging the tunnels, square cofferdams (12) by 12 ft.) were dug on both sides of the river to a depth of 24 ft. below the water level.

Tunnels . . . On the Canadian side, there is a 90-ft. concrete tunnel, 4½-ft. high with a flat bottom, 4 ft. wide. This type of tunnel conformed to Canadian construction requirements.

On the American side, the tunnel is a completely round 54-in.-diameter concrete culvert pipe with 9½-in. wall thickness, 84 ft. long.

Casing of 36-in. diameter, ⅜-in. wall, steel pipe was placed through the tunnel on each side for a distance of 93 ft. at a depth to provide for the 30-in. line to enter the bank at a point approximately 24 ft. below the surface of the water.

Trenching . . . The trench was dug in the bluish stiff clay in the river bottom to sufficient depth to provide for 18 to 20 ft. of cover. At the deepest point depth from the surface of the water to the river bottom is 42-44 ft.; to the bottom of the ditch about 60 ft. The trench was dug by Dunbar & Sullivan Dredging Co.

Backfilling was done in about 3 weeks with 2 ft. of sand on top of the

pipe and 4 ft. of rock about the size of a fist.

During trenching and pulling of pipe, the operations were surveyed by fathometer.

Concrete jacketing . . . Concrete jacketing was applied over coal-tar coating on 40-ft. joints. Both coating and concreting were done by Rosson Richards Co., at Orange, Tex. The concreted pipe was shipped all the way to the job by rail. It arrived in excellent condition. Unloading was done by crane.

For a distance of about 85 ft. at each end (American and Canadian) the 30-in. pipe is jacketed with 3¼-in. of reinforced Gunite concrete. The remaining pipe in the central part is jacketed with 1¾-in. of reinforced barite concrete.

In the air the total weight of the central part of the pipe was 433 lb. per ft.; in the water it is 30 lb. per ft.

Dollies . . . The entire 2,400-ft. concreted 30-in. pipe was laid on special dollies where it was welded and where "field joints" were protected with Gunite concrete prior to launching from the Canadian shore.

The special dollies were placed at intervals of approximately 60 ft. Each dolly has war surplus B-26 airplane landing wheels with 26 by 9-in. 10-ply tires on pin bearings with a stabilizing liquid.

This dolly equipment was first used in the laying of the products line for Imperial Oil, Ltd., at Hamilton Bay, Ont., in 1952.

Welding . . . Welding of the ½-in. wall pipe was done with 8 to 11 beads. Stringer bead was run with Fleetweld 5 and the remaining beads with Fleetweld 85. All welds were examined by radiographic inspection and found to be 100 per cent satisfactory.

Pulling . . . The 2,400-ft., 30-in. concreted section was pulled straight across the river in 1 day by two cables at the rate of approximately 10 ft. per minute. The casing was on the pipe when it was pulled.

A 1¾-in. cable was pulled by a 155-hp. gasoline-engine-driven winch located on the American shore. This winch handled 1,200 ft. before respooling.

A 1¼-in. cable was pulled by a winch on a derrick barge anchored close to the American side. This handled 2,200 ft. of cable.

While the pipe was being pulled by winches, it was also pushed by five large tractors (one D-8 and four D-7's) on land.

There were two grab ropes of hemp, each with a buoy, attached to the ends of the pipe; one was 150 ft. from the forward end, the other was 300 ft. from this end.

The ships in the river did not draw more than 26 ft. The cable sagged well below the draft of the ships.

Operations on the banks . . . From the landward ends of the tunnel, on each side of the river, the line ascended a 16 per cent grade to an overbend which is about 150 ft. from the tunnel. Distance between valves on both sides is 2,700 ft. (distance from bank to bank 2,020 ft.; length of concrete-coated section pulled, 2,400 ft.)

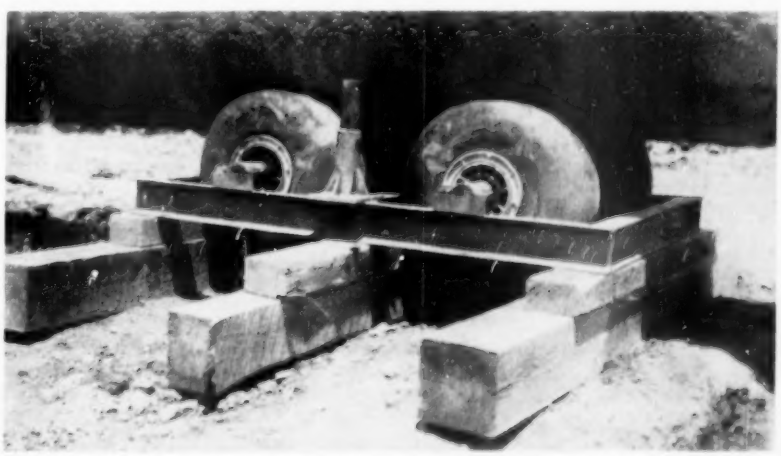
Banks were rip-rapped with "one-man stones."

COFFERDAM SHAFT and target marker on Canadian side.

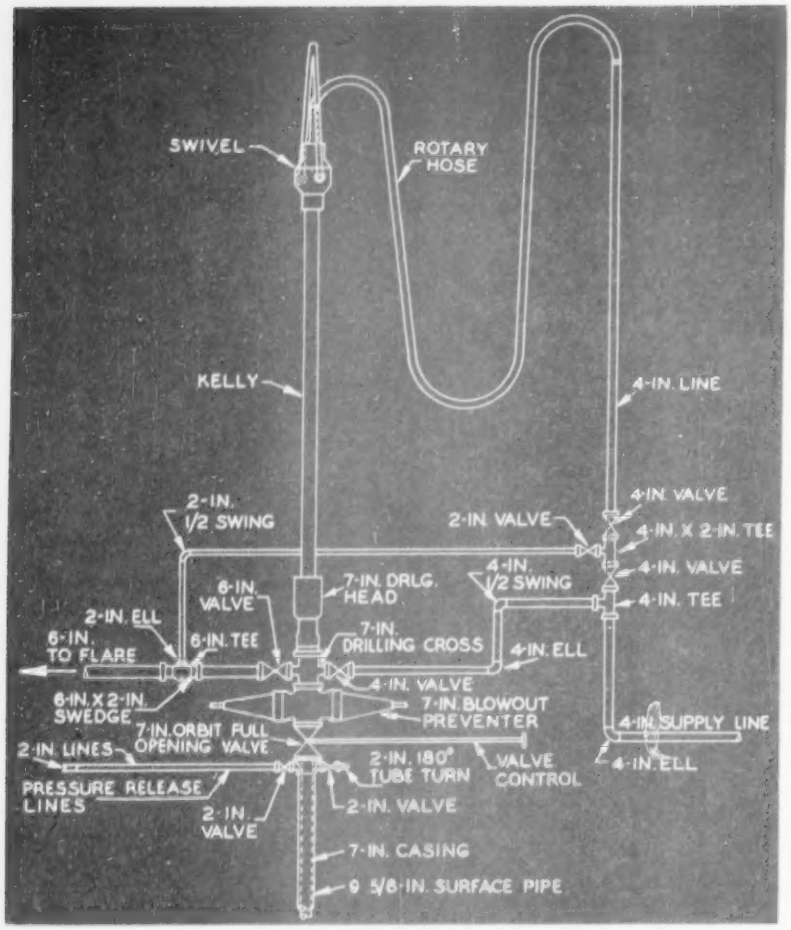
LANDWARD END of tunnel on Canadian side.

The construction of the Lakehead Pipe Line Co. Superior-Sarnia project was managed by Bechtel Corp. under the direction of Clark Rankin, project manager. At the crossing, Clyde A. Farris was superintendent, and J. J. Taggart, welding inspector, and R. E. Duke, engineer for Bechtel.

Operations of the contractor, Midwestern Constructors, Inc., were directed by F. E. Stanley, president, and C. C. Bledsoe, secretary-treasurer. At the crossing, the undertaking was supervised by R. C. Stanley, superintendent, and E. C. Rolfe, engineer. The work on the Canadian side was done under the name of Comstock Midwestern, Ltd.



SPECIAL DOLLIES with B-26 airplane landing wheels supporting 30-in. pipe ready for launching.



STANDARD WELL HOOKUP for drilling with gas.

MUDLESS DRILLING

When Is It Practicable to Drill With Air and Gas?

1. Surface holes, where lost circulation prevails.
2. Drilling low-pressure gas sands.
3. Redrilling old wells where pressure is reduced.
4. In areas where water is scarce.

by L. S. Fuller

THE completion and drilling of oil and gas wells where gas or air is used as a circulating medium has been successfully accomplished for many years. A study of the records shows that experimental work on gas drilling was done as far back as 1938 when oil wells were completed by using compressors and a closed gas circulating system. In almost all cases, experimental operations have proved that air or gas is an excellent circulating medium when the equipment is properly selected and the conditions for the use of air or gas are proper. It has been shown that the use of air or gas can result in a very large savings in money and drilling time, and many technical benefits relating to the productivity of the well.

Author is with El Paso Natural Gas Co., Farmington, N. M. Paper presented at Southwestern district meeting, A.P.I. Division of Production, Houston, March 3-5, 1954.

Natural gas was first used in the San Juan basin when it was first introduced by C. L. Perkins, vice president and general manager of El Paso Natural Gas Co., in 1951, and was used by the company's drilling department to complete the first of many wells.

Gas drilling has been used to drill wells in excess of 9,000 ft. in depth and in the past year there have been instances where wells have been drilled, with air, to below 7,000 ft., with apparent good success. In general the application for air and gas drilling will fall into four main classifications:

1. Drilling of surface holes, where lost circulation is a large problem or the drilling of any section in a well where lost circulation prevents ordinary drilling methods.

2. Drilling of low-pressure gas sands to prevent the contamination by normal drilling fluids and to clean out wells after they have been shot for increased production.

3. Redrilling of old wells where the formation pressure is reduced or where the oil and gas are produced from fractures or crevices or very thin sections which could be plugged by conventional drilling fluids.

4. Air and gas drilling is especially applicable where water is scarce or where the penetration rate in hard formations is improved by air drilling methods.

San Juan Basin First

The first large-scale planned program where gas has been used for the completion of gas wells in the San Juan basin in northwestern New Mexico was when El Paso Natural drilled the first of its many wells in May 1951. This completion operation was so successful that since that time the company has completed in excess of 300 wells by using natural gas. It is interesting to note that on the first well in which natural gas was used, only three 6¼-in. bits were needed to drill the 831 ft. of hole below the casing shoe. The drilling time was 27½ hours in comparison to the 3 to 8 weeks necessary when cable tools were previously employed. The subsequent operations have shown that not only has there been a great deal of time saved in the actual drilling operations, but the number of fishing jobs has been considerably reduced. An additional large savings is

in the time which has been saved in the cleaning-out operation after the well has been shot. Due to the characteristics of the Mesaverde formation the use of mud or other liquids as a circulating medium during the cleaning-out operation was a costly operation which gas drilling has reduced a great deal. Lost circulation was very common after the shot was fired and many times it was very difficult to obtain satisfactory production if fluids were used in drilling and cleaning out. Cleaning-out time was actually reduced to a matter of hours where normally it was a job which often took weeks.

Benefits which can be claimed for the use of air or gas as a drilling fluid in the San Juan basin are:

1. Faster drilling rates and less cleanout time. An an example, the average drilling rate has increased 85 per cent, and the cleanout time has improved a great deal. The over-all savings has been calculated to be approximately $20,000 per well.

2. Gas drilling has removed the possibility of contaminating the producing zone.

3. Gas drilling allows the testing of low-pressure zones, and the well can be tested in stages as it is being drilled or cleaned out.

Drilling Problems

Problems connected with drilling with natural gas or air have been solved as experience was gained. Drilling pressures have been varied a great deal and satisfactory results have been experienced in using pressures from 80 to as high as 450 psi. The higher pressures drill more efficiently, and it can be said that 250 psi. is the minimum pressure at which operations can be successfully completed.

Usually fewer drill collars are needed while drilling with gas or air because less weight is needed to obtain a high penetration rate. In the San Juan basin 20,000 lb. and 80 r.p.m. is all that is required to drill a 8¾-in. hole in most formations encountered. A 6¼-in. hole is drilled very rapidly with 6,000 to 8,000 lb. of weight on the bit, which is a reason the life of the bit is extended.

Hard-formation-type bits seem to drill faster in both hard and soft formations which is probably the result of the fact that the hard-formation bits cut the formations in small particles which are more quickly removed from the hole by the gas stream. If high circulation pressures are used, standard tool joints do show considerable wear on the tool-joint shoulders; however, flush-joint pipe is now being run in the area, and it is reported that very little wear is noticed from the sandblasting effect.

The most troublesome problem to overcome in drilling with air and gas is when water is encountered either above the drilling point or in the bottom of the hole. Normally, if water is encountered the hole must be dried up before drilling any considerable distance. This is especially true in a deep well.

If the cuttings from the bit are mixed with water in the proper proportions, they will cake up inside the casing and will cause the drill pipe to stick when the bit is being withdrawn from the hole. Sometimes the water can be squeezed off, or if water is encountered in large quantities, a string of casing can be run to shut the water off.

Influencing Factors

There are a number of factors which influence the seriousness of the effect of the water on gas drilling. The first, of course, is the quantity of water. The power to remove a large quantity of water from the bore is considerable and will use up a great deal of the energy supplied by the compressors. Water produced from the bottom of the hole may cause upper formations, which normally are dry and firm, to cave and stick to the drill pipe. If the cuttings which are carried by the air stream are made particularly sticky by the water they are likely to build up a mud ring on the inside of the casing which will stop the withdrawal of the bit. This can be very serious, as many times a producing horizon will be open below the bit, and if the circulation should become plugged the high pressure which might build up under the stuck bit can blow the string of drill pipe from the hole. In addition, great care must be taken, if the bit becomes stuck, not to rotate inside of the casing because the rotation of the bit will unscrew the casing.

At the present time there are experiments being carried on with chemicals which cause normally sticky mud to lose its stickiness and allow it to be ejected with the fluid without danger of cuttings sticking to the inside of the casing string. There are, also, chemicals now being developed which show promise of having the property of stabilizing the wall of the well bore so that water being carried upward by the air stream will not cause the side of the bore to swell or cave.

Drilling Equipment and Operations

In San Juan basin practice, where gas is used for well completion, the piping setup is relatively simple. The well-head equipment differs little from the regular equipment used on a normal well. The only addition to the standard blowout equipment is a rotating head which prevents the escape of gas from around the kelly, and a simple piping setup for the gas supply.

The exhaust is discharged through a 300-ft. long, 6-in. pipe at the end of which is located a pilot flare, to ignite the gas as it is discharged.

A connection is made by shutting off the gas supply and allowing the pressure in the drill pipe to discharge into the flow line. A float valve above the bit prevents the gas in the well or production from the formation to escape upward through the drill pipe while the connection, or trip, is being made. All formation production will be discharged outside of the drill pipe and this in the normal manner will be blown out the flow line.

Hazards of Drilling With Gas

There has naturally been a great deal of controversy concerning the hazards or dangers of drilling with gas. It is true that if the proper precautions are not followed there are, as in any other drilling operation, dangers to the personnel and to the equipment used in drilling the well.

In general, a standard and reasonable safety program which is not different from that in ordinary drilling procedures will prevent any abnormal accident hazards. For instance, all blowout equipment should be tested every 8 hours and if it is not found to be in the best of working order it should be repaired. Blowout equipment should be especially secure because when drilling with natural gas or air the driller does not have the effect of a heavy column of mud to help him control the well.

In regard to fire, smoking on the rig is probably responsible for at least 85 per cent of all of the fires in our area where gas was being used. It is natural that men will get careless with cigarettes and matches because if they cannot smell the gas they do not recognize the danger.

The first rule of drilling with natural gas is No Smoking. We no not allow the men on our company rigs to bring either cigarettes or matches on the rig floor and in many cases a smoking area is designated for the crew. The crew soon becomes used to handling gases under high pressures and they develop the necessary precautions in bleeding off large volumes of high pressures, gases, etc.

Natural gas is dangerous if proper ventilation is not provided, and every precaution is taken to eliminate concentration of gas near the engines or under the derrick floor. All connections are checked regularly for leaks; and safety valves used to shut off the gas flow are located at a safe distance from the rig.

CASE HISTORY . . . Unitization, and Water and Gas Injection, Hackberry Field, Louisiana

by R. L. Evans and A. E. Barry

THE Hackberry-pressure maintenance program includes both water and gas injection. The two were initiated in 1945 and 1950, respectively.

Hackberry dome is situated in Cameron Parish, southwestern Louisiana, 15 miles from the Gulf of Mexico and 25 miles from the Texas-Louisiana boundary. The structure is a piercement-type salt dome, 5 to 7 miles in cross-section, its long axis trending east and west. The cap rises to within 2,000 ft. of the surface at either end of the dome, creating two features separately recognized as fields and designated as East and West Hackberry.

Production operations date back to the 1920's but as in the case of most salt domes, exploration around the flanks progressed slowly. New productive areas have been encountered as recently as 1952 when development of deep Oligocene deposits on the west flank commenced.

The West Hackberry Unit

The area under discussion, the West Hackberry Unit, lies on the northwest flank of the dome. Production contained in the unit was discovered in December 1940 with the drilling of a well now designated as unit well No. 6. This and subsequent wells ultimately defined a productive area extending 11,000 ft. along strike and at its widest point, approximately 1,250 ft. downdip. The productive area included in the unit embraces 232 acres.

The development program ultimately identified three main productive sands of Oligocene age designated Camerina "B," "C," and 'D" zones in order of depth. The sands are steep, having a dip of 60°. Rather than pinching out against the salt, they are truncated by an interruption interpreted as a low-angle peripheral fault.

The Camerina "D" sand is the most important of the three main reservoirs, having potentialities greater than the other two combined, and presenting the more severe production problems. It has an average vertical thickness of 95 ft. and a maximum productive closure of 1,900 ft. between depth of 8,100 and 10,000 ft. The Camerina "C" sand, next in importance, has an average thickness of 106 ft., and a maximum productive closure of 1,000 ft. between depths of 8,050 and 9,050 ft. The Camerina "B" sand has an average thickness of 49 ft. and a productive closure of 11,000 ft. between depths of 8,000 and 9,100 ft.

The physical characteristics of the three sands and their reservoir fluids are very similar. The sandstone is medium grained and lightly cemented with a shaly matrix that appears quite competent under reservoir conditions, but breaks down readily on contact with fresh water. Physical characteristics have been evaluated in the laboratory by conventional core analysis, capillary-pressure tests, and special multiphase flow analyses. The reservoir crude oils which are undersaturated have been evaluated by conventional pressure-volume-temperature analyses of bottom-hole samples.

AVERAGE CHARACTERISTICS, CAMERINA ZONES

Porosity, per cent	30
Permeability, md.	1,500
Interstitial water, per cent	16
A.P.I. gravity	30
Solution gas-oil ratio	500
Saturation pressure	3,300
Reservoir volume factor	1.3

Camerina "D" Water-Injection Project

The Camerina "D" sand is producing under water-injection pressure maintenance, initiated in 1945. This sand was the principal objective of early drilling operations, and soon demonstrated a volumetric control mechanism. The initial bottom-hole-pressure measurements in the reservoir were made in January 1941 at which time 43,000 bbl. of oil had been produced. Pressure averaged 4,439 psi. at datum of 9,600 ft. By January 1942, 11 wells were completed in the reservoir, production had reached its peak level of 2,500 bbl. per day, 583,000 bbl. of oil had been produced and the reservoir pressure had dropped 566 psi. Production rates were promptly reduced 50 per cent and a period of observation ensued.

The abrupt decline in pressure was an unexpected development in the area, previous experiences having indicated that water drive was the usual displacement mechanism. In the case of the "D" sand it was still expected that a water drive of some dimension would materialize, once bottom-hole pressure had declined sufficiently to induce flow into the reservoir. The aim during 1942 and 1943 was to reduce producing rates by increments to a rate at which water influx would balance withdrawals and the reservoir pressure would be stabilized at a level higher than the bubble point.

It was established early in this process that pressure could not be sustained at a desirable producing rate, and an experimental water-injection pressure-maintenance program was undertaken. Pending the initiation of pressure maintenance, rates were progressively reduced to a level of 25 bbl. per well per day without stabilization of bottom-hole pressure.

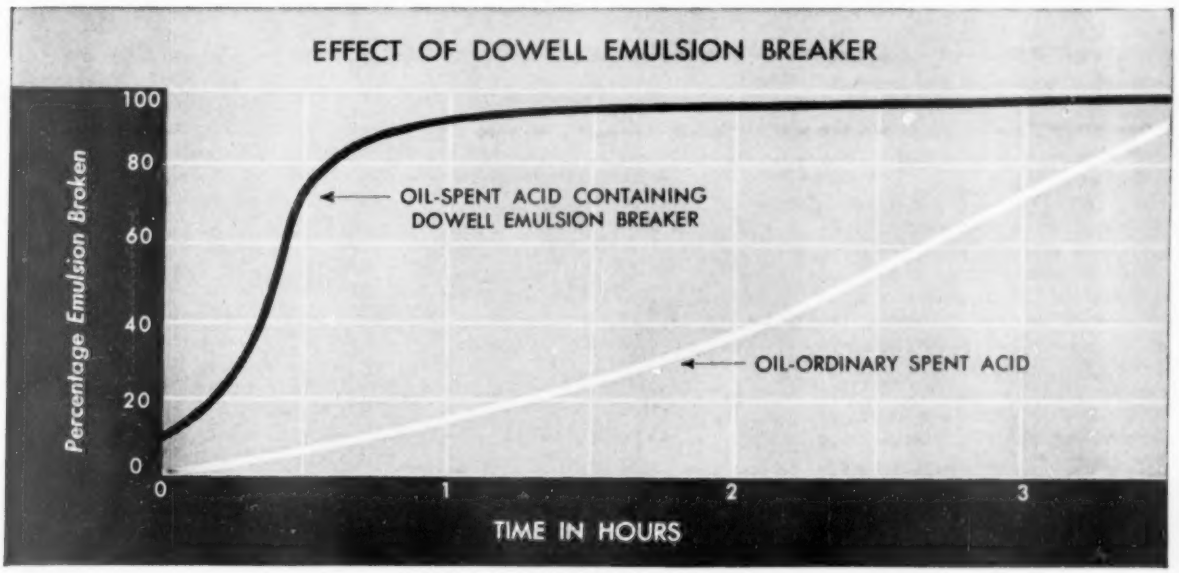
The implications of the predominantly volumetric nature of the reservoir are of course obvious. According to concepts prevailing at the time, it signified relatively inefficient recovery of oil from the sand, as compared to expectations in a water-drive reservoir. Loss of productive capacity with pressure decline and an extended and expensive reservoir life during depletion by artificial lift are inherent in volumetric-type reservoirs. In this case, moreover, the bottom 300-500 ft. of the oil column had been penetrated by only four wells in the entire 11,000-ft. length of the reservoir and none of the wells encountered the oil-water contact, consequently the prospects of recovering an appreciable portion of that reserve without drilling a lower band of wells were dubious at best.

By contrast, water-injection pressure

Authors are with Stanolind Oil & Gas Co., Lake Charles, La. Paper presented at spring meeting of Southwestern District, A.P.I. Division of Production, Houston, March 3-5, 1954.

EMULSION PROBLEM IN NEW WELL SOLVED WITH XW ACID TREATMENT

Fast clean-up resulted from DOWELL treatment with inhibited acid plus demulsifying agent



A wildcat well—5123 feet deep, with 77 feet of broken pay in hard, dolomitic lime—was exceptionally difficult to bring into production because of the presence of a stable oil/water emulsion.

The well could be produced only by bailing. Then, the operator contacted Dowell. After a careful laboratory study of the emulsion, Dowell recommended a three-stage treatment using inhibited acid containing surface tension reducing and emulsion breaking agents. The second stage of the treatment resulted in 2 BOPH production, swab and flow. The third and final stage brought a substantial production increase, flowing with no emulsion trouble.

Dowell addition agents have been developed to provide operators with answers to many of the difficult conditions encountered in oil, gas and water wells. These developments are the result of over 21 years of experience in oilfield services using chemicals. Other Dowell additive chemicals are designed to remove mud from producing formations; to speed reaction rate; to increase penetrating ability; to remove "gyp"; to trace fluid movement; to increase acid weight.

For more information on Dowell XW Acid, other addition agents and the many oilfield services and products offered by Dowell, contact the nearest Dowell Office. Or, write directly to Tulsa, Dept. D-11.

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FOR OIL INDUSTRY CHEMICAL SERVICE

maintenance promised a much higher recovery factor without shrinkage losses, sustained productive capacity during well life, and a means of eliminating the need for downdip development. The latter advantage was offset to some extent by the requirement for injection wells. It was believed, however, that several factors would facilitate a fairly uniform upward movement of the water-oil contact even though a minimum number of injection wells might be used. The high permeability of the formation would minimize the type of pressure gradients that induce coning. The high angle of dip and the appreciable difference in density of the reservoir oil and salt water should generate a healthy gravity force tending to cause the water to seek a level rather than rise irregularly.

The principal unknown was the critical factor of reservoir continuity, without which a uniform flood could not be obtained. Interference tests were of no value since the drawdown of most of the wells involved is within the limits of accuracy of present bottom-hole-pressure bombs. Pressure uniformity in the sand was encouraging, but withdrawals had also been relatively uniformly distributed, a consideration which rendered pressure data inconclusive.

Water Injection Started

The experimental project was initiated in February 1945 with the objective of defining the feasibility of a program embracing the entire reservoir, and of maintaining reservoir pressure above the bubble point until a final decision had been made. The initial injection rate was 1,500 bbl. per day into the east salt-water-injection well, which had been drilled to serve the program.

Plant . . . The physical facilities at Hackberry in connection with the water-injection project are not unusual. The source well which produces salt water from a Miocene sand at 2,500 ft. was necessary, as laboratory tests on Camerina sand cores indicated fresh water was not suitable. There is no drawdown in the source well while delivering at the capacity of the pump even for extended periods of time. The average daily salt-water production is about 3,000 bbl. Water is delivered to a 100-bbl. storage tank with a gas-vapor blanket, which prevents the injection from coming in contact with the atmosphere and also serves to automatically control the amount of water delivered from the source well.

Filter . . . From the storage tank the water flows through a sand filter to eliminate the plugging of the injection wells by the removal of suspended particles. The filter is backwashed daily but requires no other maintenance. The water from the filter is chemically treated to eliminate scale formation and flows into a manifold arrangement with separate metering facilities to record injection rates and volumes into each of the injection wells. This arrangement also allows gravity or pressure injection selectivity into the wells.

Ordinarily the well adjacent to the handling facilities takes its daily quota of water by gravity. The other injection well which is located about 1 mile away from the source well requires use of the pump. Injection into the wells has been relatively trouble free. On the few occasions that surface pressure had risen to the 600-psi. output of the injection pump acidization of the wells has increased their injectivity to the original level. The first injection well was given special consideration during completion and was underreamed, gravel packed, and screen was set. The second well, however, is a typical set-through completion with the entire sand interval perforated with both bullets and jet shots.

Results . . . Producing rates were restricted during the first year until a substantial increase in reservoir pressure had been effected. Rates were increased gradually from 1946 through 1948 and monthly bottom-hole pressure surveys were made to follow alterations in pressure distribution. The results of the program were encouraging and it was decided to unitize the properties and expand to full-scale operation. Although the pressure effects of injection were fairly uniformly transmitted to the extremities of the reservoir, there was a possibility for non-uniform movement of the water level. To prevent this, producing rates were again restricted in 1949 pending the conclusion of unitization negotiations, and were not restored to higher levels until the unit had been formed and another injection well added.

Operations were restored to normal in late 1950. The division of injection volumes between two wells would tend to mitigate any irregularities encountered in the rise of the water contact; however, a further improvement was effected by regulating individual well allowables in proportion to their distance from injection wells. Any irregularities that remain are thought to be attributable to permeability variations which permit rapid advance of water through a small proportion of the pay. These do not interfere seriously with our plans, and since no wells have completely flooded out that have not logically done so as a function of depletion, we are satisfied that the operation is successful up to the present time.

The water level now stands at approximately 9,700 ft. by virtue of the injection program, and in the course of this advance we have recovered over 4,000,000 bbl. of oil, a large proportion of which was displaced from a position below the "D" sand intervals in the existing wells. This has been accomplished for the investment equivalent of three wells, two of which were actually drilled for injection purposes. By comparison with depletion drive, and neglecting any variation in recovery factors for reasons discussed below, substantial additional gains have been realized through prevention of shrinkage losses.

Camerina "B" Gas-Injection Program

The Camerina "B" sand is subjected to a gas-injection program initiated in 1950. This sand was of secondary importance during the initial development of the field, the majority of the completions in it being made dually with the Camerina "D."

As a result of retarded development, production did not exceed 300 bbl. per day until 1943 when the dual-completion campaign got under way. During the period, reservoir pressure remained stable at the original level of 4,140 psi. at a datum of 9,000 ft., and the reservoir was interpreted to be under water-drive control. As producing rates were increased, however, the reservoir sustained a pressure drop as abrupt but less severe than that observed in the Camerina "D" sand. Rates were consequently restricted in 1944 to 1,500 bbl. per day as a first stage in seeking an equilibrium rate. In this case the bottom-hole pressure stabilized at the reduced rate, verifying the water-drive

". . . water-injection pressure maintenance promised a much higher recovery factor without shrinkage losses, sustained productive capacity during well life, and a means of eliminating the need for downdip development. . . . The high permeability of the formation minimized possibility of the type of pressure gradients that induce coning."

Another new development using

B. F. Goodrich Chemical *raw materials*

Brown Duo-Pak Packer made by Brown Oil Tools, Inc., Houston, Texas. B. F. Goodrich Chemical Company supplies the Hycar rubber as the raw material for the packing element.

Dual-Purpose packer seals above and below—

another job for HYCAR

MOST packers do only one job in an oil well. The one pictured here is a *dual* purpose packer, designed to confine applied pressures to the producing zone. It holds against pressures from both above and below—protecting the upper casing string from high pressures, while fracturing or acidizing the area to increase flow from the well.

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"By means of this program (water-injection pressure maintenance) 26 of the 27 wells in the unit would retain their utility for 12 or more years. Nineteen of the wells would retain their utility for 20 or more years. Final depletion would be accomplished by 10 wells in an additional 5 to 7 years."

concept, and exploitation proceeded in the manner typical of such pools, the producing rate declining as completions flooded out.

It is not difficult to conclude from this record that the gas-injection project had its inception in other aspects of the operation than observed performance. Actually, there were three principal considerations involved. First, the prospect of early floodout of the remaining "B" sand completions; second, the necessity of updip and pinchout development to deplete all of the Camerina sands, and third, the possibility of gravity drainage as a production mechanism.

The first two considerations are self-evident. Of the 27 wells drilled in the unit to date, 10 were situated low on the structure and 16 below midstructure. With all sands producing under natural or artificial water drive, available wells would be reduced by one-third before a quarter of the reserves had been produced. This deficiency would have to be made up by additional drilling or sidetracking designed to provide completions as close as possible to the updip pinchouts in three sands. The possibility of obtaining completions right at the pinchout would be slight.

A single alternative presented itself in the growth of a better understanding, industrywide, of the role of gravity drainage in depletion-drive reservoirs. A few gas-injection pressure-maintenance projects had been designed for the express purpose of stimulating gravity-drainage benefits. Here at Hackberry appeared to be an ideal situation for enlargement of the method. The high permeabilities and steeply dipping beds are ideally suited to the technique.

The method was advanced as a control that could stabilize water levels and maintain well utility. It was also postulated, with less certainty, that gas need not be injected at the apex of the structure to migrate into the pinchout and displace oil downdip to the available wells. Since available information ascribed extremely efficient recovery factors to the mechanism, it appeared that the traditional superiority of water drive was too conjectural to be considered a valid condemnation of the proposal.

The "B" sand was selected for trial because it was most critically in need of stabilization to save wells, and because its smaller size affords a better opportunity to obtain data within a reasonable time for evaluation of the prospects of the technique in larger sands. Accordingly gas injection was initiated in the structurally highest well available, 17 Hackberry Unit, in August 1950.

Plant . . . Physical facilities for the gas-injection project consist of a gathering system, which is connected to all the leases on the northwest flank, and a compressor plant. The plant consists of two 300-hp. units which take gas from the gathering system at 65 psi. and compress it to 650 psi. The plant is arranged so that the gas can be delivered to a third 300-hp. compressor which raises the gas pressure to the injection level of 3,200 psi. or if necessary, gas can be taken from the low-pressure compressor discharge automatically for delivery to the field gas-lift system. Ordinarily all of the gas is injected into the "B" sand; this averages about 2,500 M.c.f. per day.

Hydrate formation in the high-pressure injection gas has been eliminated by a regenerative glycol dehydration unit. The injection well is an ordinary set-through completion and has been effective as both an injection and producing well. There has been no plugging of the injection well and since the original acid treatment no further work has been necessary.

Following the initiation of injection, withdrawals were continued at a restricted rate while the reservoir pressure was built up by overinjection. The purpose of this procedure was to force stabilization and, if possible, retirement of the oil-water contact in order to protect the remaining wells in the sand. The attempt was partially successful in that producing characteristics of one of the water-producing wells improved slightly. This would indicate a definite but moderate recession in the water level. Further retirement of the water level is fairly unimportant and it is believed that the preferable policy for the future will be to balance injection and withdrawals with the reservoir pressure stabilized at a level compatible with adjacent formations.

Of interest with regard to this project, also, is the continuity of the reservoir and the ability of gas to migrate laterally along the pinchout. The only means of examining this aspect has been to maintain observation of the injection well in order to detect the passage of the gas-oil contact. This is accomplished by gently backflowing the well as opportunity permits to determine whether a permanent gas phase has been established at the level of injection. Thus far, it has been found that the injection interval resaturates in a matter of hours and the hole fills with oil. This prompts the conclusion that injected gas has in fact migrated updip.

It is believed that this experimental project has confirmed the correctness of certain of the concepts on trial, and the practicability of depleting pinchout oil by gas injection. Already over 1,000,000 bbl. of attic oil has been displaced and the gas-oil contact is still above the injection well which is the highest completion in this sand.

Camerina "C" Sand

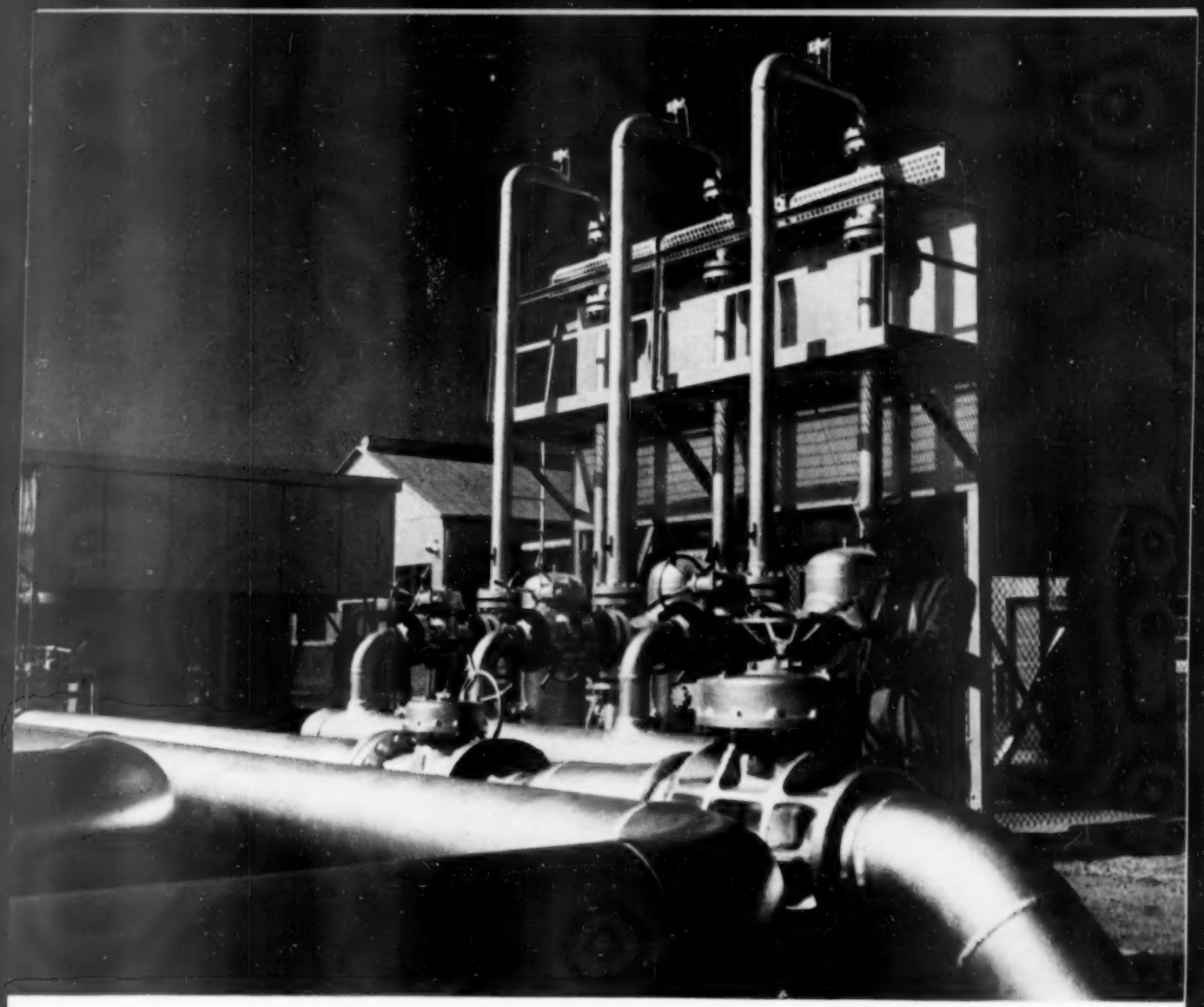
The Camerina "C" sand has exhibited a very active water drive. Some thought will be given to gas injection to recover attic oil in the final stages of depletion.

Future Operations

One investigative program contemplates an integrated pattern in which the Camerina "D" sand will be exploited concurrently by gas-injection gravity drainage and downdip water injection until the water level is stabilized at a point just below the lower band of wells. At that point, with maximum recovery of downdip oil attained, the water level would be stabilized and final depletion would be accomplished through the lower band of wells by gas injection.

The "B" and "C" sands would be produced under natural water drive through wells transferred from the "D" sand as its gas-oil contact moves downstructure. The final phase would consist of flooding the "B" sand up to the previously established gas-oil contact, displacing pinchout oil from the "C" sand by gas injection, and blowing down the stored gas reserve in the "D" sand for sale or injection.

By means of this program 26 of the 27 wells in the unit would retain their utility for 12 or more years. Nineteen of the wells would retain their utility for 20 or more years. Final depletion would be accomplished by 10 wells in an additional 5 to 7 years. Thus far the recovery and operation of the programs at Hackberry have exceeded original expectations.



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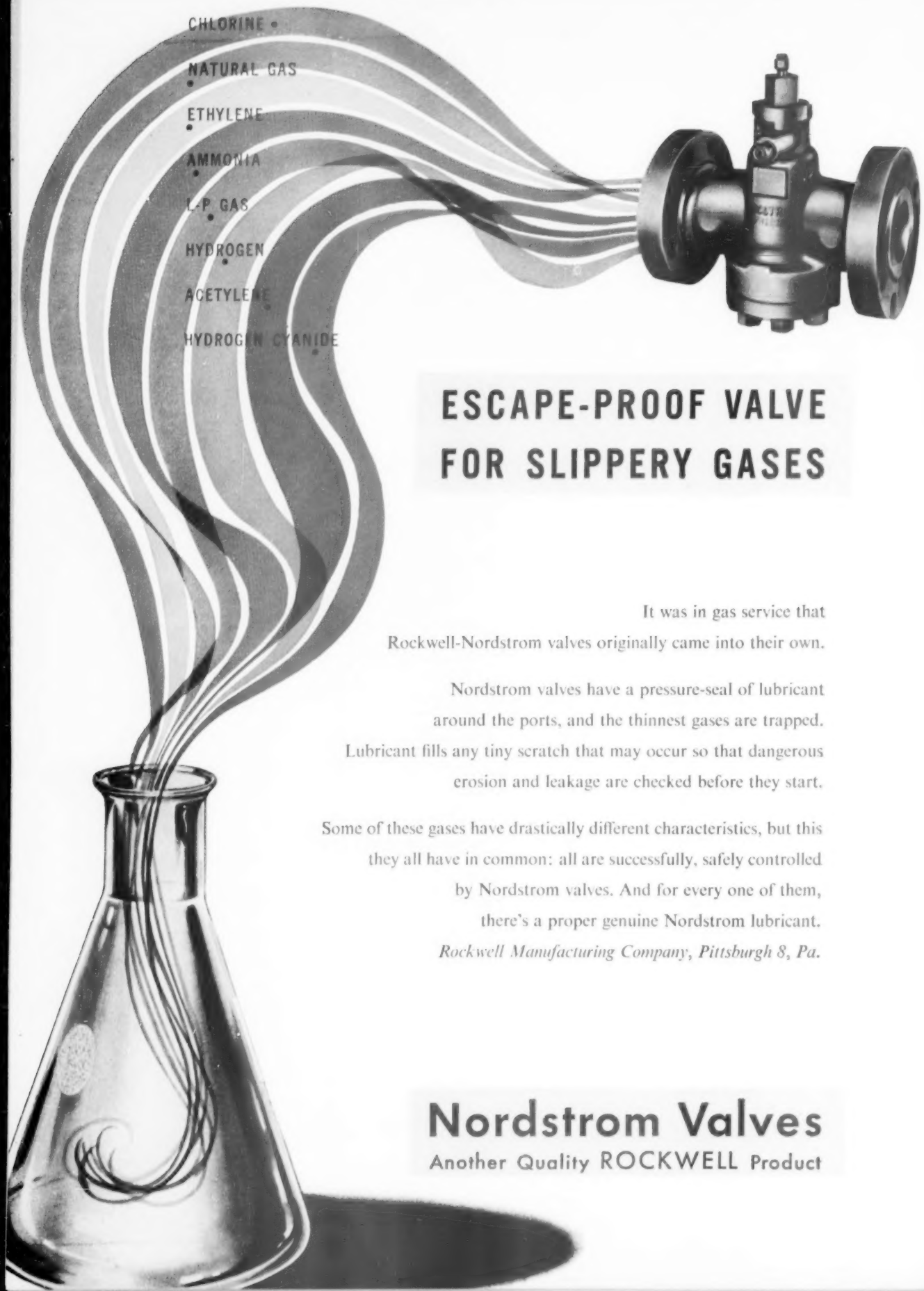

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Nordstrom Valves

Another Quality ROCKWELL Product

Evaluation of New Instruments

(Continued from page 101)

gives the approximate phase shift found for the particular frequency. Amplitude is determined visually by watching the output change.

The same motor and crank disk arrangement can be connected to a crank arm which in turn compresses or extends a bellows as shown in Fig. 2. This hookup was used to point out how a U-tube manometer operated. Fig. 3 shows some of the results obtained by this equipment.

A test of this sort shows quickly that even a simple measuring device such as a U-tube manometer is a very unusual operator when the input pressure is changed according to a frequency basis. Tests of this sort bring out many things that are important to the actual operation of the unit. Application limitations are evident in this case. Damping of the impulse lines to the U-tube manometer was necessary and could be accomplished, to eliminate the excessive errors when undamped. Tests of this sort have been made quickly and cheaply on a number of types of equipment. Two makes of piston-operated valves and a single make of diaphragm-operated valve have been tested. Some of these tests are shown in Fig. 4.

Flow transmitter . . . One test was made of a new model flow transmitter coupled by a magnetic bend. The magnetic bend mechanism was counterbalanced by several heavy weights which interjected such a mass of moving parts that, even at very slow frequencies, the couple was broken. Under static calibration the instrument calibrated quite readily. As a result of some of these tests, in the future, equipment specifications will include certain requirements as to frequency-response performance. Quick tests may also minimize the number of cases of improper installation or even improper application.

Evaluation and development are very closely associated. It is difficult at times to determine where one stops and the other starts. Development work is generally preceded by evaluation to establish the direction of a development. In the case of the piston-operated valves, one make was tested with shims on the inlet air pilot to give it a higher air capacity. In the case of the other valve, it was tested with increased air supply pressures with noticeable improvement. Each change is accompanied by another evaluation to establish a new limitation to the operation of the equipment.

As an example, an initial investigation of an electronic potentiometer pointed out certain limiting factors in its design. The research laboratory made a few quick changes and within a matter of a few weeks, the sensitivity of this potentiometer was improved as much as a thousandfold. In many cases, findings or results of the tests are reviewed with the manufacturer for the mutual benefit of both parties.

Gas Storage

(Continued from page 107)

on two of the fringe wells for a period of approximately 1 hour in order to obtain gas and oil samples. The wells produced a relatively small volume of 50°-A.P.I.-gravity oil but due to the short duration of the tests no attempt was made to calculate gas-oil ratios.

One significant observation from the field operations to date is that the five wells which were completed through perforations in casing cemented through the reef have shown considerably less producing capacity than the injection well completed in the open-hole section. One of the large contributing factors to this difference in capacity appears to be the plugging action of the drilling mud and lost-circulation material which invaded the formation in these wells. None of these wells yet have been treated with acid in significant quantities and it is planned to acidize these wells later when the reservoir pressure has been increased.

It is contemplated that the storage cushion will be fully established at the end of the current heating season. Normal operation of the field as a storage reservoir will begin this spring and a brief outline of the proposed future operation appears to be in order.

Gas injection normally will be commenced during March or April after the reservoir pressure has been reduced to 1,000 psig. by withdrawals during the winter season and injection will be continued through the month of November. As the compressor station is capable of filling the reservoir during 200 days, it is obvious that excess compressor capacity will be available during a portion of this injection period to cycle gas produced from this reservoir. In this respect, it is planned that tests will be conducted to determine the optimum operating pressure range at which oil can be produced and data now available appear to indicate that the minimum pressure for this operation is in excess of 2,000 psig. Cycling of gas from the fringe wells will be started during the latter part of the annual injection period and continued as desired until the withdrawal of gas is begun. The estimated volume of gas which can be cycled for oil production during this period is approximately 500,000 M.c.f.

Withdrawal of gas from storage will begin during November and continue through a part of the following March. Most of the gas withdrawn from storage will be produced from the injection wells but it is anticipated that approximately 500,000 M.c.f. of gas can be withdrawn from the oil-producing wells early in the heating season while the reservoir pressure is sufficiently high to permit efficient operation of these wells.

In summary, a normal storage cycle would include injection of approximately 4,000,000 M.c.f. of pipe-line gas during an 8-month period with the compressors being utilized partially or wholly to cycle gas for oil production during the later portion of this period and withdrawal of approximately 4,000,000 M.c.f. during the remaining 4-month period, a small portion of this withdrawal being produced from the fringe wells directly into the pipe line.

BOOKS

1954 PAY ALMANAC. By William J. Casey, J. K. Lasser, and Walter Lord. Published by Business Reports, Inc., Roslyn, N. Y. 166 pp. $12.50.

This loose-leaf volume surveys the major problems and opportunities in rank-and-file and management pay during the current year. Comparative data are presented to help management set intelligent pay policies for executive, office, and production groups. Among the factors discussed are: profit sharing, stock plans, pensions, welfare benefits, expense deals, comparative pay data, and union contract data. According to the Almanac, smaller pay increases, 3 to 6 cents an hour, and a continuing push on welfare benefits will feature wage settlements in 1954. For rank-and-file workers, the trend is away from long-term pay contracts, escalator clauses; is toward cementing in past cost-of-living gains. The book should be helpful to managements in all lines of business in guiding them toward a successful policy.

REPORT ON THE ELEVATED-TEMPERATURE PROPERTIES OF CHROMIUM-MOLYBDENUM STEELS. Published by the American Society for Testing Materials, 1916 Race Street, Philadelphia. 212 pp. $4.75.

This is the second in a current series of reports prepared under the auspices of the Data and Publications Panel of the A.S.T.M.-A.S.M.E. Joint Committee on Effect of Temperature on the Properties of Metals. This report is a graphical summary of the elevated-temperature strength for the chromium-molybdenum steels. It includes summary curves for tensile strength; 0.2 per cent offset yield strength; per cent elongation and reduction or area; stresses for rupture in 100, 1,000, 10,000, and 100,000 hours, and stresses for the creep rates of 0.0001 and 0.00001 per cent per hour and Larson-Miller master curves. The volume contains 200 figures including summary curves for 23 steels, and more than 250 data sheets for 52 steels.

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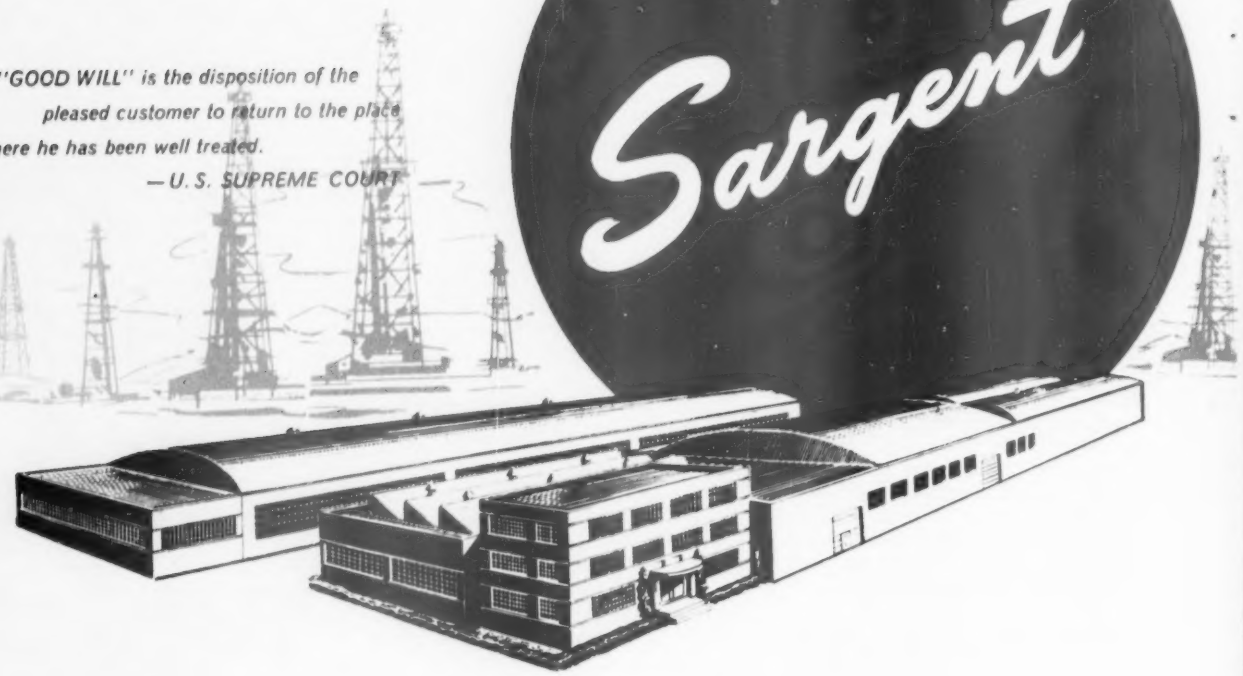

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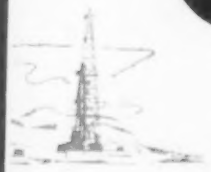

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How to Size Vapor-Relieving Systems—4

by Joseph Conison

A NEW pressure-drop equation, designed to simplify calculations, was derived in Installment 3. Preceding installments discussed critical and noncritical flow and line sizing. An example of the use of this equation and its modifications is given in this concluding installment.

Another method generally used is the calculation of the pressure drop at constant temperature and in increments of pressure drop by starting with the terminus and working back to the relief valve. When using the Fanning equation, the maximum pressure-drop increment is limited to 10 per cent of the average pressure.

The constant-temperature approach noted above was selected on the basis of employing a factor of safety. Theoretically, the temperature of the vapors along the header would be less than the temperature at the outlet of the valve due to the vapor expansion and loss of heat due to conduction and radiation depending on climatic conditions. Not knowing the degree of the variables, the writer is of the opinion that a slightly larger, but yet conservatively calculated line, especially when plant protection is at stake, will compensate in some degree for the engineering assumptions and theory that do not always follow in actual practice.

1. Find P_t when using a 12-in. i.d. pipe. Referring to Equation 5.

$$P_t = \frac{W}{d^2}\sqrt{\frac{RT}{k(k+1)}} \Big/ 11{,}400$$

$$= \frac{\frac{95{,}270}{144}\sqrt{\frac{1{,}544}{44}\,\frac{690}{1.3(1.3+1)}}}{11{,}400}$$

$$= 5.2 \text{ psia.}$$

As P_t is less than atmosphere, then P_2 will be equal to 14 psia.

(Note: If P_t were greater than 14 psia., then P_2 would be assigned that value.)

Author is senior instrument engineer with Fluor Corp., Ltd. Paper presented at A.S.M.E. meeting, Los Angeles.

$$V_2 = \frac{v_2 w}{A} = 14.3 \times \frac{95{,}270}{3{,}600} \times \frac{4}{\pi(1)^2} = 480 \text{ ft./sec.}$$

$$R_e = \frac{\rho D V_2}{0.00806\mu} = \frac{0.07 \times 12 \times 480}{0.00806 \times 0.012} = 4{,}200{,}000$$

$$f = 0.014$$

Using Equation 14:

$$P_1 = \sqrt{P_2^2 + \left(\frac{fl}{D} + 2\log_e \frac{V_2}{V_1}\right)\frac{V_2^2 P_2}{g v_2}}$$

$$P_1 = \sqrt{(14 \times 144)^2 + \left(\frac{0.014 \times 1{,}400}{1} + 2\log_e \frac{V_2}{V_1}\right)\frac{480^2 \times 14 \times 144}{32 \times 14.3}}$$

$$P_1 = \sqrt{(4.08 \times 10^6) + (19.6 \times 10^6) + \left(2 \times 10^6 \log_e \frac{480}{V_1}\right)}$$

As a first approximation, ignore $(\log_e 480/V_1)$.

Then:

$$P_1 = 1{,}000\,(23.68)^{1/2} = 4{,}860 \text{ psfa.}$$

$$= (P_1 = 4{,}860/144 = 34 \text{ psia.})$$

The specific volume at the outlet of the valve is equal to:

$$v_1 = \frac{P_2 v_2}{P_1} = \frac{14}{34} \times 14.3$$

$$= 4.2 \text{ cu. ft. per lb.}$$

And the velocity equals:

$$V_1 = \frac{W v_1}{A} = \frac{95{,}270}{3{,}600} \times \frac{4}{\pi} \times 4.2$$

$$= 142 \text{ ft. per sec.}$$

Therefore:

$$2\log_e V_2/V_1 = 2\log_e 480/142$$

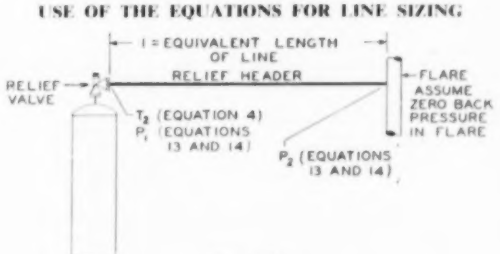
$$= 2.44$$

And applying the correction for the log term:

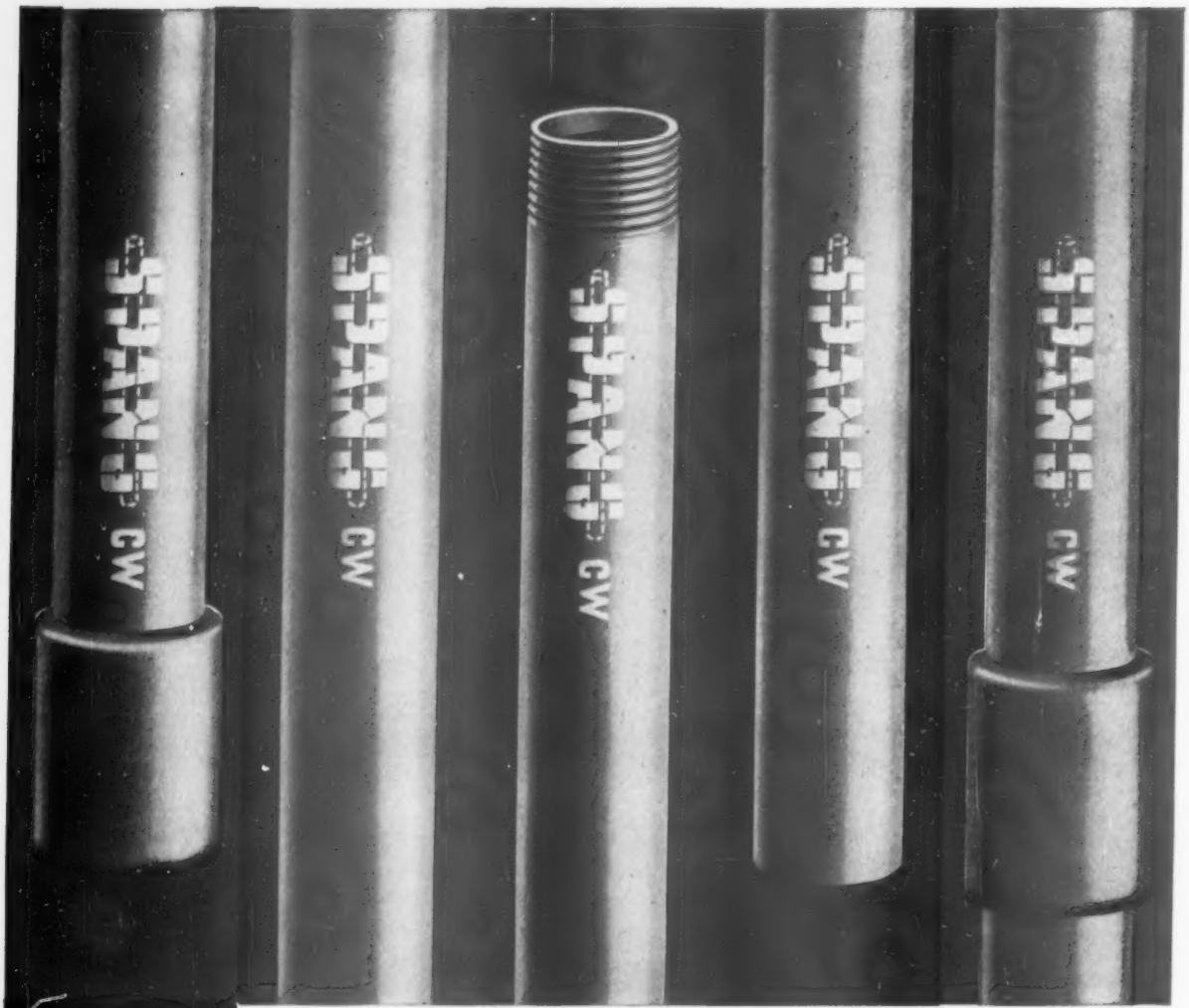
$$P_1 = \frac{1{,}000\,(23.68 + 2.44)^{1/2}}{144}$$

$$= 34.4 \text{ psia.}$$

USE OF THE EQUATIONS FOR LINE SIZING



Example:
Relieve 95,270 lb. per hour of vapor in header.
Outlet temperature of valve, $T_2 = 690°$ R.
Atmospheric pressure = 14 psia.
Specific vol., v_2, at 14 psia. and 690° R. = 14.3 cu. ft./lb.
Length of line, l, = 1,400 equivalent feet.
Maximum pressure drop permitted in header is 35 psi.
"k" of vapor = 1.3.
Molecular weight of vapor = 44.



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What to Do About Lost Circulation—2

by J. M. Bugbee

NEAT cement has no place as a lost-circulation plug because its density is high, above 16 lb. per gal. (120 lb. per cu. ft.). It is very fluid and lacks gelling or angle-of-repose properties. A long column of such a fluid in the drill pipe in a well which has lost returns with a lightweight mud, drops with high velocity and is likely to do nothing but make the loss zone more open.

Gel-cement plugs have been used for over 20 years in attempts to plug loss zones. Their main application is where the loss zone is at bottom, as with the Devonian losses in the Canadian plains. There are a number of reasons why gel cement is an unsatisfactory plugging agent. The density is relatively high, about 14 lb. per gal. (105 lb. per cu. ft.) is the minimum; it contaminates, both in placement and while drilling out, all drilling fluids except the lime muds; in placement there is always the possibility of sticking the drill pipe and the plugs are, therefore, rarely squeezed; in drilling out there is always the possibity of losing the hole by sidetracking the plug. Another unsatisfactory plug is the sodium silicate-clay plug which is an expensive, difficult plug to place and has never been widely used.

When a gel-cement plug has been displaced to a loss zone and a good fill-up secured, the upper part of the plug will be drilled out with full returns. Often, however, as the bit nears bottom returns are lost and it is usually assumed that the zone was not fully sealed. In many instances, however, the second loss should be attributed to the increased pressure resulting from pumping out a long column of thickened, cement-contaminated mud. Oil-bentonite or time-setting clay plugs do not have this disadvantage.

Author is with Shell Oil Co., Houston. From a paper presented at A.P.I. Division of Production meeting, Fort Worth.

It should not be concluded, however, that a gel-cement squeeze is not sometimes an important lost-circulation corrective. Cannon has described such an application in a 16,255-ft. East Texas well having more than 11,000 ft. of open hole, a high-pressure sand "kicking" from bottom, and lost returns. Some successes with "burlap plugs" have recently been reported in the Rocky Mountains. Squares of burlap or canvas, 1 or 2 ft. on a side, are rolled up and lubricated into a gel-cement plug through a lubricator located between the well-head and cementing truck. The cloth can be considered to be reinforcing material and to increase the angle of repose property.

New developments . . . In the past 3 years, three new types of plugs have been developed. These have low densities, will not stick drill pipe, and do not contaminate drilling fluids. Oil-base mud of certain types will thicken immensely when contaminated with water or drilling mud. Displacement of 5 bbl. into a loss zone, where it thickens on mixing with mud and formation water, is a useful lost-circulation corrective.

Diesel-oil spacers ahead of and behind the oil-base mud could be used, but in most applications are omitted.

The diesel or crude oil-bentonite (approximately 300 lb. of bentonite suspended in each barrel of oil) plug is a similar plug. The mixture is very fluid when being displaced; but when formation water and drilling mud contaminate and mix with it, the material thickens to resemble modeling clay. Diesel-oil spacers are generally used with these plugs. The time-setting clay plug is also a recent development and is reported to have been successful in some instances.

Soft Plugs and Bridging Particles

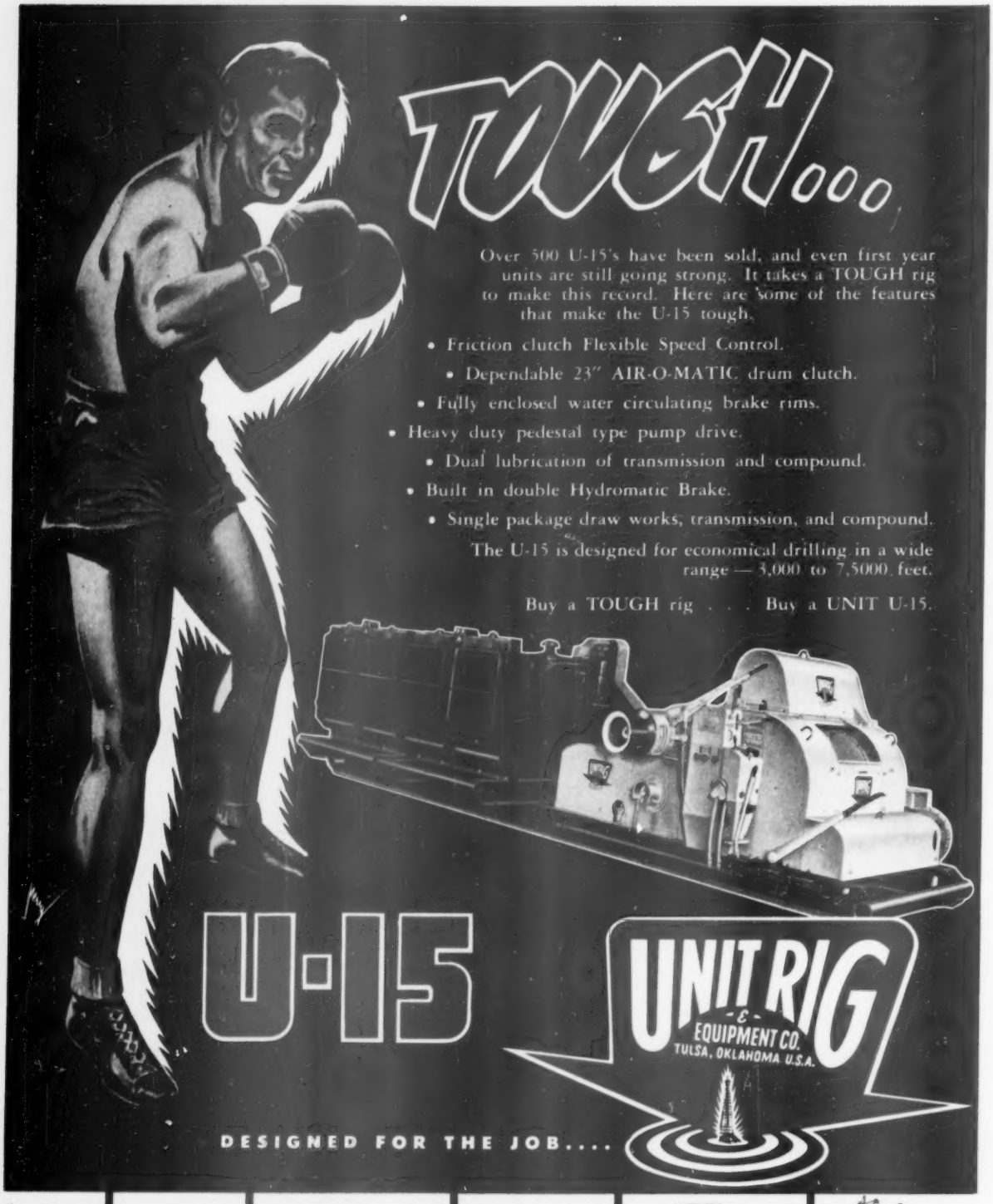
The commercial lost-circulation matereials are generally well known and may be classified into two groups: (1) fibers and flakes which includes plant, wood, bark, wool, leather and synthetic fibers, and cellophane or cork flakes and mica; (2) bridging particles, which include expanded perlite, coated coke fragments, walnut shells, and gravel pebbles.

Recent work indicates that a concentration of about 14 lb. of flake or fibrous matetrial per barrel of mud will bridge over fissures with widths up to 0.10 to 0.12 in. Increased concentrations will not bridge on fissures of greater width and simply pass through.

The critical concentration with a bridging-particle material is believed to be about 20 lb. per bbl., and the critical width of fissure between 0.18 and 0.20 in.

When a serious loss is encountered, a good present practice would be to mix 50 to 150 bbl. of mud near the pump suction, to a concentration of 14 lb. per bbl. of a mixture of three of the fibrous and flake materials (or to a concentration of 20 lb. per bbl. of expanded perlite). It may then be displaced into the loss zone as a plug.

Such treatments can be repeated several times to insure that the batch of loaded mud has been displaced into the loss zone. If circulation is not established, recourse must then be made to a plug of the type that stiffens in the loss zone. If circulation is regained, the shale screen should be used to remove any of the lost-circulation material which has the circulating mud.



Over 500 U-15's have been sold, and even first year units are still going strong. It takes a TOUGH rig to make this record. Here are some of the features that make the U-15 tough.

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- Heavy duty pedestal type pump drive.
- Dual lubrication of transmission and compound.
- Built in double Hydromatic Brake.
- Single package draw works, transmission, and compound.

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U-15

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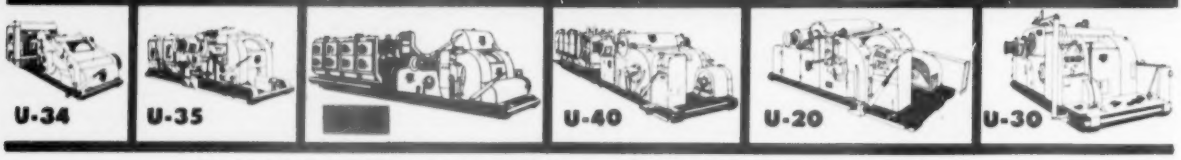

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PETROLEUM PRODUCTS

How to Determine Diluent in Used Railway Diesel Lubricating Oils—1

by L. L. Davis and H. E. Luntz

This series deals with the dilution of diesel engine oils in service and methods for the determination of the amount of diluent in used oils. A correlation between the decreases in flash and viscosity with the per cent and character of diluent is recommended for control of engine operations.

THE rapid increase in the use of diesel engines, particularly in railway locomotives, during the past few years has emphasized the need of simple, quick methods for the determination of the quality of used diesel lubricating oil in actual service. One of the more serious changes in oil quality in service which may affect the safe operation of the engine is the decrease in viscosity and flash caused by dilution.

Oil dilution . . . This may occur either through the slow accumulation of the heavy ends of the diesel fuel oil during normal service or the rapid leakage of fuel into the oil because of some abnormal mechanical condition. Under normal operation of railway diesel equipment, the diluent tends to reach an equilibrium at from 1 to 5 per cent concentration, and the decrease in viscosity and flash does not reach hazardous levels. Under abnormal conditions, such as direct leakage of fuel through a broken injector, the diluent may quickly reach dangerous levels.

From a practical operation viewpoint, safe engine operation can be insured by establishing a minimum permissible viscosity and flash for the crankcase oil. Routine checking of the oil at intervals set by experience should prevent unsafe oil conditions. Such control is unsatisfactory in that it gives no measure of the quantity and character of diluent and therefore does not indicate the probable cause of the trouble.

Authors are with development and research department, Continental Oil Co., Ponca City, Okla.

Existing Methods

Literature search as well as private communications from many diesel-engine operators and lubricating-oil manufacturers failed to disclose any satisfactory laboratory procedure for the determination of the amount and character of the diluent in a used diesel engine oil. Several procedures are currently used to estimate the relative amount of dilution.

1. Viscosity decrease . . . The majority of operators and oil laboratories use the decrease in viscosity of the oil as a basis for not only oil-change control but also for the estimation of the per cent dilution. The usual procedure is to assume the diluent has the viscosity of the fuel oil and then estimate the percentage of dilution by use of any of the several available viscosity blending charts.

The procedure does give relative values; but the estimated quantity may be greatly in error, since the viscosity of the diluent may be as much as several times as great as that of the fuel itself. Thus, a used oil from an engine with a broken injector was found to contain about 32 per cent of diluent having a viscosity of about twice that of the fuel. Using the viscosity of the fuel to estimate the amount of diluent as discussed above, the per cent dilution would be 23. In used oils from normal operations with actual heavy diluent content of 3 to 5 per cent, the estimated diluent by the viscosity decrease method will be only about one-half the true value.

2. Decrease in flash . . . Some operators report the use of the Pensky-Martens flash of the used oil for control of oil quality. This procedure does protect against unsafe excessive dilution but is even less dependable than the viscosity decrease for the estimation of quantity of diluent. This is due to the lack of flash blending correlations and to the fact that the flash of the diluent varies as much as its viscosity.

3. Flash and viscosity . . . A few operators report the use of both flash and viscosity of the used oil for control of crankcase oil quality. No specific correlations have been reported; and in general the practice consists of establishing permissible decreases in flash and viscosity for safe engine operation.

4. Institute of Petroleum method . . . Although the Institute of Petroleum method for the determination of diluent in used diesel lubricating oil is not used by American operators, its accuracy was checked with oils of known diluent content (see Item 6 below) with results as shown in Table 1.

TABLE 1—DILUTION TESTS, INSTITUTE OF PETROLEUM METHOD

	Oil		
	A_1	A_2	B_1
Known diluent content, per cent	3.44	2.29	31.7
Diluent by I.P. method, per cent	2.5	0.5	23.5
Viscosity, cs. at 100° F.:			
Used oil	161.2	179.7	36.75
After I.P. steam	188.5	190.2	160.5
New oil	197.7	197.7	207.7

The failure of the I.P. steam distillation to return the viscosity of the used oil to the new oil value indicates failure to remove all of the diluent.

5. Distillation procedures . . . No operator or oil laboratory reported the use of a distillation procedure for the routine determination of diluent in used oils. Over the past 5 years extensive laboratory studies in cooperation with several railway laboratories have failed to find a usable correlation between any simple distillation procedure and diluent content.

6. Research technique* . . . In connection with this investigation, a research technique was developed for the separation and identification of diluent from used diesel engine oil. The method includes, first, distilling the used oil under vacuum (1-2 mm. absolute pressure) to produce an overhead fraction containing all the diluent and, second, fractionating the overhead into 1 per cent cuts in a true-boiling-point still.

By comparing the boiling points and viscosities of each fraction to similar fractions from the new oil, it is possible to calculate the per cent of diluent and to blend portions of samples to reconstitute and test the diluent itself. Determinations of "diluent" content of known blends is accurate within about 1 per cent of the diluent. When the same amount of reconstituted diluent was blended with new oil, the viscosity of the "synthetic" used oil checked the viscosity of the actual used oil within an average of 3 per cent.

The quantity and characteristics of the diluent in three used railway diesel oils have been determined by this technique. These are shown in Table 2.

Successful application of the method involves use of specialized equipment and skilled personnel for the operation of this equipment.

Viscosity and Flash Decrease

A graphic correlation has been developed between the amount of diluent and the resultant decrease in flash and viscosity. By the use of this correlation, reasonably accurate estimates can be made of the amount and character of the diluent from the flash and viscosity of the used oil.

For this purpose the Pensky-Martens closed-cup flash (A.S.T.M. Method D-93) was selected as being more sensitive to minor content of diluent than the more commonly used open cup flash method. This should theoretically be true, and preliminary comparative tests confirmed the fact.

An example of the graphic correlation will be given in the next installment.

TABLE 2 — DILUENTS SEPARATED FROM USED RAILWAY DIESEL LUBRICATING OILS

Sample used oil—	A1	A2	B1
Amount of diluent, per cent	3.44	2.29	31.7
Diluent:			
Gravity, A.P.I.	35.4	34.2	34.4
Flash P.M., °F.	255	255	210
Vis., cs. at 100° F.	4.51	5.05	3.39
Distillation at 10 mm.:			
10 per cent	276	301	226
50 per cent	332	355	302
90 per cent	388	418	392

*Abstract from draft copy of paper on "The Dilution of Diesel Engine Oils in Service," by L. L. Davis and H. E. Luntz. Copies may be obtained from Librarian, Development and Research Department, Continental Oil Co., Ponca City, Okla.

What happens to

Dissolved Water in Aviation Fuels

DISSOLVED water and entrained water in fuels are of particular interest in aircraft operation because, at low temperature, this water could form ice. Ice would deposit on fuel filters and control mechanisms and adversely affect fuel flow and engine performance. With the advent of long-range, high-altitude flights, fuel temperatures will be lower and the tendency for water in the fuel to form ice will be greater. The use of micronic filters in fuel lines will maximize the danger of plugging from any ice present.

Solubility of water in hydrocarbon-type materials depends mainly on temperature and hydrocarbon composition. Solubility increases directly with temperature in a predictable manner. The effects of composition, on the other hand, are not so clearly defined.

A convenient linear relationship between solubility and temperature is obtained, over the relatively narrow range of temperatures usually encountered with aviation fuels, by relating the log volume per cent dissolved water to temperature in °F. Examination of such a chart shows why a filter icing problem would be anticipated in aircraft-equipped with micronic size filters. A warm, saturated fuel, as would be obtained from a water displacement storage and dispensing system would not be able to hold the water in solution when the temperature is lowered. At temperatures below 32° F. this water would be likely to form ice.

A majority of aircraft tanks and storage tanks that hold aviation fuels are equipped with vents. Consequently, fuels are usually in contact with the atmosphere from time of manufacture. This atmospheric contact has a marked effect on the water content. Whenever a fuel is stored in a vented tank the water content of the fuel will attempt to come to equilibrium with that of the atmosphere contacting it. Thus, water is lost from a saturated fuel exposed to dry air and is gained by a dry fuel contacting humid air.

Laboratory and other studies were made to note effect of relative humidity, low temperature, vent size, fuel surface area to fuel height in tank, vapor space, air temperature, and altitude. Such studies indicate that filter icing from dissolved water precipitating from a warm fuel on cooling may not be the problem as originally envisioned. With good venting, the water should have an opportunity to escape before the fuel temperature is low enough to freeze the water. The actual problem with adequately vented tanks may be caused not by water originally dissolved in the fuel at time of refueling, but rather by water condensed in the plane tanks when planes descend from altitude to warmer air of high absolute humidity.

—From paper by A. B. Crampton, R. F. Finn., and J. J. Kolfenbach, Standard Oil Development Co. Paper presented at S.A.E. meeting, Atlantic City, 1953.

ELECTRIC LOGGING—24

How to Interpret Departure Curves

by R. I. Martin

BECAUSE of the large number of similar-shaped curves it is often difficult in practice to decide which is the correct interpretation. Fig. 1 is an example of this. The bed thickness is 10 times the hole diameter. Each combination of the three values Ri/Rm, Di/d, and Rt/Rm is practically identical in each column.

Such indeterminate cases may be resolved to a certain extent if Ri/Rm is known definitely and also if Di/d can be estimated approximately.

It is also possible to find practical coincidence between curves, or sections of curves, corresponding to beds of different thicknesses. In particular, points derived from logs of beds of finite thickness, say less than 50 d, can often be matched with curves shown on charts for beds of infinite thickness. In such a case, if Rt is higher than Rs, the value derived from this comparison is a lower limit for Rt. Conversely if Rt is lower than Rs the value found is an upper limit for Rt.

Fig. 2 shows a log of a bed of finite thickness. It may be considered to be reasonably homogeneous in spite of the ripple shown on the normal resistivity curves. The following information applies:

Rm, mud resistivity corrected for temperature is 0.2 ohm-m.

Author is assistant professor of petroleum engineering, Missouri School of Mines and Metallurgy.

Rs, resistivity of adjacent formation: 0.5 to 1 ohm-m.

d, hole diameter, 8⅝ in.

AM, short normal, 16 in.

AM′, long normal, 64 in.

AO, lateral, 18 ft. 8 in.

e, bed thickness, 32 d.

AM/d = 1.85 Ra = 7 Ra/Rm = 35
AM′/d = 7.4 Ra = 10 Ra/Rm = 50

The lower limit for Rt/Rs shown on the charts for e/d = 30 is 3 and the ratio of Rs/Rm is between 2.5 and 5. Hence Rt/Rm should at least be equal to 3 × 5 = 15. When the experimental points are plotted in Fig. 3, it appears that this condition is satisfied.

Reference to Table 1, Installment 23 shows that the value of Ra/Rm for the long normal of 50 is within the interval where Rt/Rm is practically equal to Ra/Rm, provided the depth of invasion is not greater than Di/d = 2. If such is the case Rt/Rm can be taken as equal to 50, and Rt = 10.

If it cannot be assumed that the depth of invasion is small, then various departure curves may be tried. Some of these are shown in Fig. 3. It appears that the depth of invasion is more likely to be Di/d = 2, than deeper. It also appears that Rt/Rm lies between 40 and 51 which agrees with the previous result.

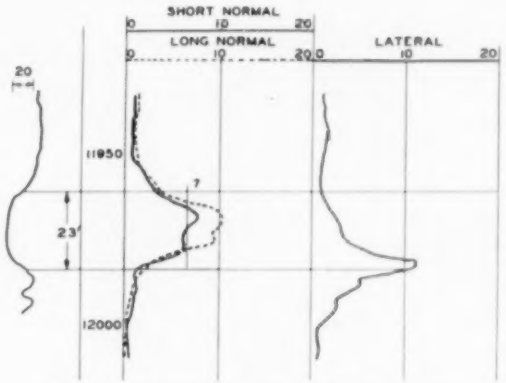

Fig. 2—Field example for a bed of finite thickness.

$\frac{Ri}{Rm}=6$ $\frac{Di}{d}=2$ DOC. 3, PAGE 111	$\frac{Ri}{Rm}=11$ $\frac{Di}{d}=2$ DOC 3, PAGE 115
$\frac{Rt}{Rm}=6$	$\frac{Rt}{Rm}=4$
$\frac{Rt}{Rm}=12$	$\frac{Rt}{Rm}=8$
$\frac{Rt}{Rm}=20$	$\frac{Rt}{Rm}=15$
$\frac{Rt}{Rm}=30$	$\frac{Rt}{Rm}=22$

Fig. 1—The case of equivalence for thin beds (e = 10d).

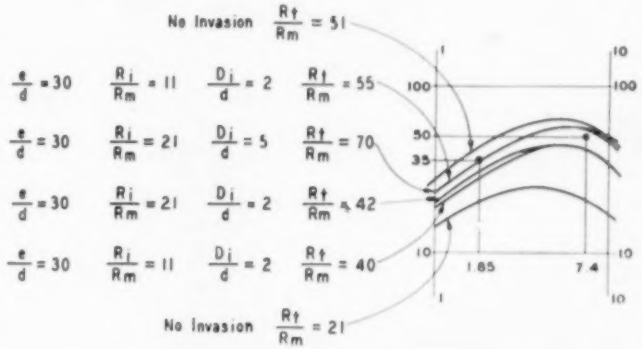
No Invasion Rt/Rm = 51
e/d = 30 Ri/Rm = 11 Di/d = 2 Rt/Rm = 55
e/d = 30 Ri/Rm = 21 Di/d = 5 Rt/Rm = 70
e/d = 30 Ri/Rm = 21 Di/d = 2 Rt/Rm = 42
e/d = 30 Ri/Rm = 11 Di/d = 2 Rt/Rm = 40
No Invasion Rt/Rm = 21
1
10
100
50
35
1.85
7.4

Fig. 3—Interpolation between departure curves. All figures from Schlumberger Well Surveying Corp. Document 4.

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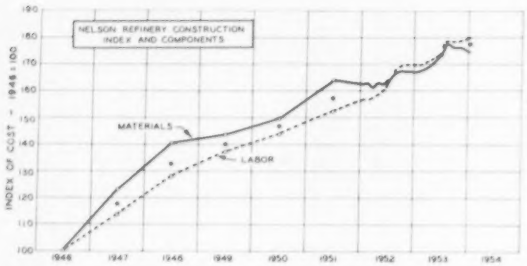
COST-imating

by W. L. Nelson
Technical Editor

Labor and Material Costs Moving Into Balance

ACCORDING to the chart shown here, labor did not begin to reap its share until late 1952. Now labor and materials costs are assuming a more proper balance but wages may need to be decreased if prices continue to decrease.

The cost indexes on this page may be used to bring the prices of the Cost-imating Series (October 21, 1948, through December 29, 1949) to current prices. Similar itemized cost indexes are published quarterly in the first weekly issues of January, April, July, and October. In addition, the Nelson Refinery Construction Index appears in the first weekly issue each month on the Refining page of The Oil and Gas Journal.



Itemized Cost Indexes

(Multiply the 1946 prices of the Cost-imating Series by these Index Numbers divided by 100.)

	1948	1950	1951	1952	1953	Dec. 1953	References*	Index for earlier years (The Oil and Gas Journal unless noted) in Cost-imating issues
Labor:								
Skilled construction	125.0	140.0	148.3	157.9	167.3	171.4	Eng. News Record	No. 55—Nov. 3, 1949
Common labor	131.0	148.1	156.8	168.2	181.2	187.1	Eng. News Record	No. 55—Nov. 3, 1949
Refinery construction	128.0	144.0	152.5	163.1	174.2	179.3		No. 61—Dec. 15, 1949
Refinery operation	126.0	137.6	149.1	155.1	165.2	169.2	Sur. of Current Business	No. 55—Nov. 3, 1949
Equipment or materials:*								
Boilers, tanks and sheet metal	†140.0	†136.0	†156.1	†153.4	†150.3	149.6	Code 10-72	April 21, 1952§
Boiler tubes, 2-2¼ in.	†135.0	149.5	163.3	168.8	186.3	196.0	Code 10-14-61	
Building materials (nonmetallic)	147.1	154.8	164.3	164.4	171.1	174.8	Code‡ 13	No. 22—Mar. 17, 1949
Brick—building	122.8	132.5	141.2	140.6	142.8	144.4	Code 13-41	No. 20—Mar. 3, 1949
Brick—fireclay	133.3	153.4	165.3	167.1	181.8	190.2	Code 13-42	
Castings (foundry products)	144.6	152.9	167.2	168.0	176.8	181.1	Code 10-15	No. 46—Sept. 1, 1949
Clay products (structural, etc.)	121.3	134.6	145.2	145.8	153.1	157.9	Code 13-4	No. 20—Mar. 3, 1949
Concrete—ingredients	119.4	125.3	132.7	132.7	137.8	140.4	Code 13-2	No. 22—Mar. 17, 1949
Concrete—products	118.9	124.4	132.8	132.6	135.9	138.2	Code 13-3	
Electrical machinery	127.6	134.9	154.3	152.4	156.4	160.5	Code‡ 11-7	See Marshall-S. (below)
Electrical motors and generators	128.6	135.0	155.8	154.6	157.1	159.0	Code‡ 11-73	No. 31—May 19, 1949
Electrical transformers, etc.	127.0	131.6	147.7	148.0	156.9	162.0	Code‡ 11-74	No. 31—May 19, 1949
Engines (composite)	116.9	126.0	146.1	146.5	148.1	149.7	Code† 11-54	No. 36—June 23, 1949
Exchangers	130.0	140.0	152.0	165.8	174.9	179.0	Manufacturer	No. 2—Oct. 28, 1948
Fans and blowers	131.3	162.9	190.1	183.7	185.5	192.6	Code 11-47	Feb. 17, 1949§
Hand tools	125.2	143.2	154.2	155.1	165.4	170.2	Code 10-42	
Instruments (composite)	120.0	127.8	142.3	146.2	151.9	154.0	Manufacturer	No. 34—June 9, 1949
Flow meter (mechanical)		114.0	126.8	132.3	147.8	160.3	Manufacturer	No. 34—June 9, 1949
Flow meter (air control)		138.5	157.6	160.5	170.4	178.8	Manufacturer	No. 34—June 9, 1949
Flow meter (remote)		135.5	151.7	155.2	151.5	146.0	Manufacturer	No. 34—June 9, 1949
Potentiometer, 6-point		134.0	146.6	151.5	157.8	161.5	Manufacturer	No. 34—June 9, 1949
Potentiometer, air control		134.1	136.8	144.9	152.6	150.3	Manufacturer	No. 34—June 9, 1949
Pressure controller recorder		135.6	153.3	158.4	163.7	166.3	Manufacturer	No. 34—June 9, 1949
Pressure gage		101.2	108.6	108.6	108.6	108.6	Manufacturer	No. 34—June 9, 1949
Thermometer (recording)		124.0	144.3	149.4	152.6	153.2	Manufacturer	No. 34—June 9, 1949
Control Valve		133.3	155.5	155.5	162.5	169.5	Manufacturer	No. 34—June 9, 1949
Insulation materials	126.8	125.0	128.8	130.4	133.5	136.1	Code 13-72	
Lumber (composite)	181.0	193.0	208.5	203.2	201.1	196.3	Code 8-1	No. 7—Dec. 2, 1948
Lumber (Southern Pine)	174.3	176.9	189.1	191.2	189.6	184.2	Code 8-12	No. 7—Dec. 2, 1948
Lumber (other soft woods)	206.5	230.2	252.7	248.5	256.8	251.7	Code 8-13	
Machinery—general purposes	124.9	136.7	153.0	151.8	155.1	159.2	Code 11-4	Feb. 7, 1949§
Machinery—construction	127.8	140.1	155.3	157.5	162.3	164.7	Code 11-2	
Machinery—oil field	†125.9	†135.8	†149.6	†149.9	†156.3	161.5	Code 11-51	
Paint and paint materials	143.0	136.9	153.9	151.9	150.9	152.6	Code 6-2	No. 22—Mar. 17, 1949
Paints—prepared	141.4	140.0	153.8	155.7	156.7	158.9	Code 6-21	
Pipe, sewer	†119.1	†129.9	†147.1	†146.6	†150.6	153.2	Code 13-45	No. 22—Mar. 17, 1949
Pumps, air compressors, etc.	127.0	138.2	155.9	155.6	162.5	168.3	Code† 11-41	No. 29—May 5, 1949
Steel (iron and steel)	141.1	152.9	166.7	168.5	177.4	179.5	Code 10-1	No. 61—Dec. 15, 1949
Steel—finished steel	160.4	182.6	196.9	201.2	216.6	223.7	Code 10-14	
Steel—plate and sheet		(See boilers, tanks, etc., above)						
Valves and fittings	†125.9	†135.8		¶190.8	193.1	197.0	Code‡ 11-49 (1-6 & 11-14)	No. 46—Sept. 1, 1949
Marshall-Stevens equipment (only) indexes:								
Process industries (average)	131.5	135.8	144.9	145.1	146.2	149.2	Chem. Eng. Dec. 1953	Chem. Eng. Feb. 1951
Chemical	130.0	133.8	142.5	142.8	144.4	147.0	Chem. Eng. Dec. 1953	Chem. Eng. Feb. 1951
Petroleum	132.0	136.5	145.6	146.0	147.8	150.5	Chem. Eng. Dec. 1953	Chem. Eng. Feb. 1951
Electrical power	135.0	139.3	148.3	148.7	150.5	153.2	Chem. Eng. Dec. 1953	Chem. Eng. Feb. 1951
Refrigeration	141.0	147.3	159.2	159.7	161.2	162.9	Chem. Eng. Dec. 1953	Chem. Eng. Feb. 1951
Steam power	132.0	136.6	146.5	147.0	148.8	151.5	Chem. Eng. Dec. 1953	Chem. Eng. Feb. 1951
Nelson Refinery Construction	132.5	146.2	157.2	163.6	173.5	177.6		No. 61—Dec. 15, 1949

*Code refers to the revised index code number of the Bureau of Labor Statistics, U. S. Department of Labor, "Wholesale Prices." †Estimated base value for 1946. ‡Not exactly the same items as those published before July 7, 1952. §Questions on Technology, The Oil and Gas Journal. ¶Revised.

EQUIPMENT MEN . . . in the News

Hearn Made Halliburton Regional Manager

H. P. HEARN

Hosea P. Hearn, veteran Halliburton Oil Well Cementing Co. employe, has been promoted from division manager to regional manager, according to L. B. Meaders, president.

The new regional manager is transferring from his former post as California division manager, Los Angeles, to Halliburton's Duncan, Okla., headquarters. In his new position, Hearn will supervise Halliburton's central region. This region includes the firm's North Louisiana; Central Texas; Lubbock, Tex.; West Texas-New Mexico; Dallas; and California divisions.

Replacing Hearn at Los Angeles will be Tom L. Morton, who has been assistant division manager and division engineer at Houston for Halliburton's South Texas division.

Hearn steps into the position vacated by Fred R. Whitten, who has recently retired after completing 25 years' service with Halliburton.

Hearn was employed by Halliburton during school vacations and went to work full time in 1927 as a cementing truck driver. He was made a division manager at Dallas in 1947, and since worked in the same capacity for the Rocky Mountain and California divisions.

Morton graduated from University of Oklahoma in 1940 with a B.S. degree in petroleum engineering.

Lane-Wells Makes Changes In Supervisory Sales Staff

Important supervisory and sales changes have been announced by Lane-Wells Co. in the Gulf Coast division. N. E. Wilson, subdistrict superintendent at Alice, Tex., has been transferred to McAllen, Tex., in the same capacity. G. T. Gower, formerly subdistrict superintendent at McAllen, has been assigned to Alice in the same capacity.

Ralph Grant, formerly personnel manager in Los Angeles, has been appointed district sales engineer at New Orleans.

W. H. Redford, Jr., and R. E. Pearson, formerly district sales engineers at Magnolia, Ark., and Longview, Tex., have been reassigned in the same capacity to Shreveport, La., and Magnolia, respectively.

H. M. Renfroe, who has been on military leave of absence since January 1952, has returned to the company at Alice as district sales engineer.

Schlueter Takes Philips Dealership in Tulsa

SCHLUETER

W. A. Schlueter has been appointed dealer in the southwest for products of Research & Control Instruments Division, North American Philips Co., Inc., Mount Vernon, N. Y., it has been announced by C. J. Woods, national sales manager.

The new organization will be known as Southwestern Electronics Corp., and will occupy a new building in Tulsa. The complete line of Philips X-ray analysis, radiography, and medical equipment, and the EM 75 and EM 100 electron microscopes will be displayed and demonstrated at the new headquarters. The territory served by Southwestern Electronics includes Oklahoma, Kansas, and northern part of Texas.

In 1918 Schlueter established Refinery Supply Co. in Tulsa to supply the market with highly specialized types of scientific equipment and processes. Since that time, Schlueter has served as president of Refinery Supply. He continued in this capacity after his company became a wholly owned subsidiary in 1951 of Cenco Corp. Schlueter continued as president of Refinery Supply and vice president and director of Central Scientific Co., and at the time of his resignation recently was chairman of the board.

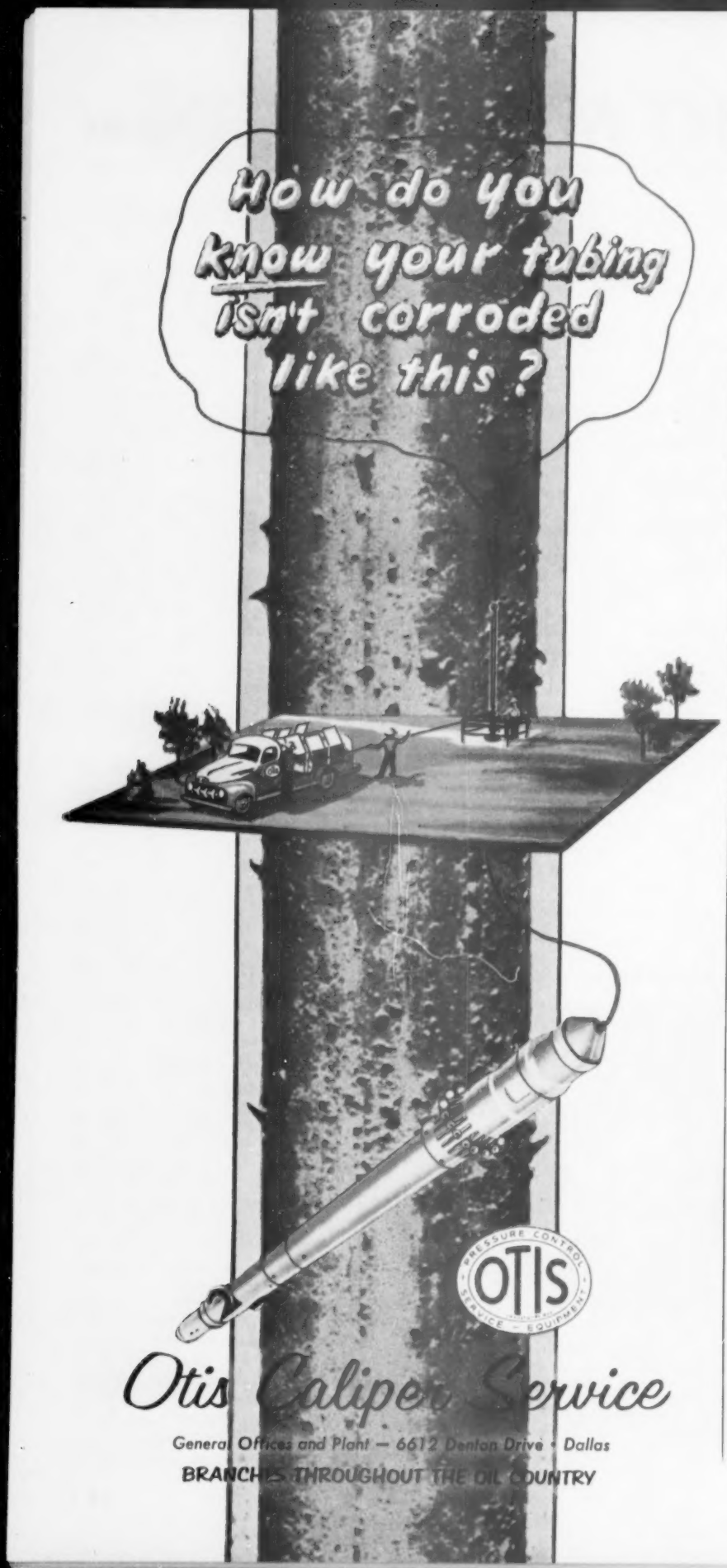
Weco Representatives Attend Houston Sales Meeting

Weco representatives from all territories gathered recently at the company's home office and plant in Houston for their annual sales meeting. The meetings, held March 2, 3, 4, and 5, were devoted to sales plans for the coming year and discussions of new products to be introduced about midyear. Attending the meeting were, front row: W. H. Brien, J. C. McCelvey, C. E. Gisler, I. D. Abshire, and C. V. Marshall. Second row: D. E. Owens; Frank Wiegand, Chiksan Co.; W. H. Stewart, W. H. Stewart & Co.; J. H. Robinson; A. H. Watts; R. E. Gammill; R. T. Jones, Chiksan; and O. J. Viator. Third row: L. L. Durkin; R. B. Feistel, Jr., W. H. Stewart & Co.; and T. R. Shields. Back row: John W. Gates, C. J. Holcomb, F. A. Jordan, and W. C. Meeks, Jr.

Marlow Pumps Opens New Texas Plant

Marlow Pumps, division of Bell & Gossett Co., with headquarters at Ridgewood, N. J., has announced the establishment of a new branch manufacturing plant at Longview, Tex. Longview is served by three major railroads, three airlines, four motor-freight lines, and five main trunk highways.

The new plant's location in the rapidly developing industrial center of East Texas offers vastly improved shipping facilities, and will offer even faster service to Marlow's customers. Marlow executives estimate that the average shipping time will be cut some 30 per cent by the move. The company's plant in De Queen, Ark., as a result of the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improved service afforded by the Longview plant, will be shut down and all operations formerly conducted in De Queen will be transferred to Longview.

The complete Marlow line of engine-driven, self-priming, and end-suction centrifugal pumps will be manufactured at the Longview plant. A balanced stock of all type pumps and parts will be maintained and service facilities will be available.

Butler Names Grant to Oil Equipment Division

C. E. GRANT

Charles E. Grant has been appointed assistant manager of the oil equipment division of Butler Manufacturing Co., Kansas City, Mo., G. A. Burns, vice president, has announced.

A graduate of Penn State College, Grant was with chromium chemical division of Diamond Alkali Co., Cleveland. Prior to that position, he was sales engineer with Bastian-Blessing Co., Chicago.

Grant will assist in the supervision of the sale of Butler's oil equipment which includes truck tanks, bolted tanks, LP-gas equipment, and welded tanks.

National Supply Men Inspect Mission Plant

A number of employes from the Houston office of The National Supply Co. visited Mission Manufacturing Co. recently for a plant inspection tour. Pictured, left to right, first row, are: Ben Goodwyn, assistant store manager, Howard Petty, field salesman; Hardy L. Donaldson, district manager; Jack Steward, of Mission; and Frank Pearson, salesman. Back row, Shad Mims, of Mission; Steve Caskie, field salesman; Bill Williams, field salesman; Johnny Robinson, salesman at Brenham, Tex.; Ray Eastridge, field salesman; Junior Wood, field salesman; and W. O. Calvert.

Lee C. Moore Assigns Hansen to South America

In order to expand services in Latin America, Lee C. Moore Corp. has assigned Donald E. Hansen to the South American territory for the company. Hansen will cover all the oil fields in the area as a sales and service engineer.

Pictured above, at a recent meeting in Tulsa, are (center) R. D. (Jack) Woods, Lee C. Moore Corp. plant superintendent, Tulsa; (right) G. I. Lynch, export manager, New York, outlining itinerary for Donald E. Hansen (left), Latin America sales and service engineer, just before Hansen and Woods left the United States for Venezuela.

Hansen will be accompanied to Venezuela by R. D. (Jack) Woods, Lee C. Moore plant superintendent who is familiar with drilling operations and the use of Lee C. Moore equipment in South America. He will continue to work in close association with the engineering department located in Tulsa.

Nordberg Heavy Machinery Announces Staff Changes

C. O. FRIEND

H. W. DOW, JR.

Organizational changes in the heavy machinery division of Nordberg Manufacturing Co., Milwaukee, have been announced by R. W. Bayerlein, division vice president.

Carl O. Friend, formerly manager, gasoline marine engine department, has been appointed administrative manager, heavy machinery division. He is succeeded by Harrison E. Fellows, Jr., assistant sales manager of this department since 1952.

H. W. Dow, Jr., formerly mideastern district manager, is named chief sales technician, heavy machinery division.

As administrative manager, Friend will be principally engaged in heavy machinery division sales research, market development, and cost analysis. He joined Nordberg in 1941, after attending University of Wisconsin and Cornell University. In 1948, he was named manager of advertising, publicity, and sales promotion activities for the company. He retained this position until 1950 when he was appointed manager, gasoline marine engine department.

Dow, as chief sales technician, will primarily coordinate sales with the engineering, contract, and production departments in addition to handling special sales assignments. He is a graduate of University of Wisconsin school of engineering. In 1936, Dow joined General Electric Co. as a test engineer. In 1937 he was assigned to the company's Schenectady office working with the marine department as general engineer for industrial and central station electrical equipment. In 1943, Dow joined Nordberg in the heavy machinery division as production engineer. Late in 1945 he was named sales engineer in this division and 2 years later was appointed to district manager, mideastern territory.

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The "SF" Lubricator provides close and accurate feed adjustments with a degree of reliability that has made it the preferred lubricator in the oil field. The advantages of easy removal of pump units, welded steel tanks, the wide variety of drives, and the new type graduated oil level gauge are outstanding McCord features. Prompt deliveries.
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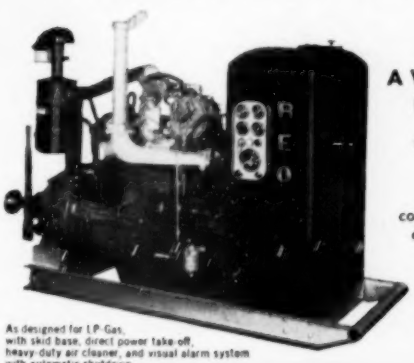
World-famous Reo spark-ignition engine design has been skillfully adapted for every need from 50 to 180 continuous horsepower. Gasoline. Natural gas. Liquefied petroleum gas. Dual-fuel combinations. For heavy-duty features and low operating costs, depend on *Reo reliability*. Write for specification and name of nearest dealer.



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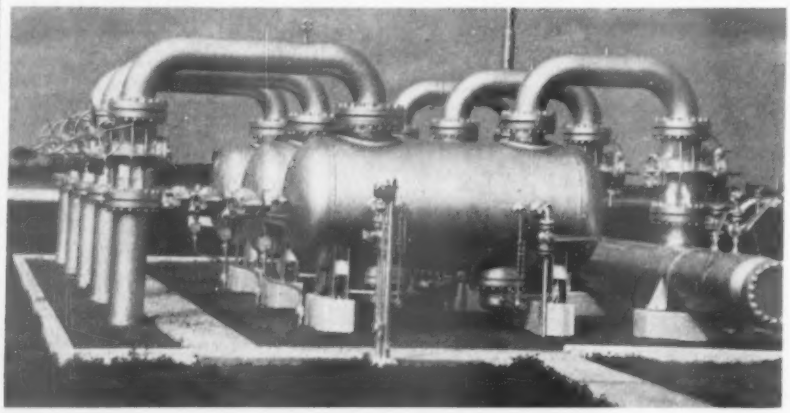
. . . Report on Construction



Scrubbers Have Rotating Cylinders Inside

EFFICIENCY of separation is greatly increased in these new horizontal scrubbers which have rotating cylinders inside. Size of the new units is about half that of the conventional upright separators which they replace. These units are at the main-line station of Tennessee Gas Transmission Co., at Bloomington, Tex., and have proved themselves in service.

Under Way, Contracted, and Planned . . .

PIPELINE activity as reported below by The Oil and Gas Journal is compiled from information received from pipeline companies and contracting firms.

These projects include those planned, proposed, under way, and contracted. Uncontracted projects are indicated by a • preceding the company name.

Crude-Oil Pipelines

• **California - Oregon Pipe Line System**—123 miles 6-in., proposed, Crescent City, Calif., to Medford, Ore.

• **Cities Service Pipe Line Co.**—60 miles, 12-in., begin March 1954, Sour Lake, Tex. to Houston, Tex.

• **Magnolia Pipe Line Co.**—208-mile, 20-in. crude line planned from Corsicana to Magnolia's refinery at Beaumont, Tex. Work expected to start during second quarter of 1954 with completion set for 6 months. The line will cross the Trinity River 10 miles south of Oakwood and will pass near Crockett, Livingston, and Sour Lake. H. B. Zachry, Cont.

• **NNCW Pipeline Co.**—127-mile line, proposed, from Weston County, Wyoming to Casper. 108 miles of 10-in. and 19 miles of 8-in. Est. Cost: $3,500,000.

• **Orchard Pipe Line Co.**—45-miles, 8-in., proposed to transport crude from Masters field in Logan County, Colorado, to point 4 miles northwest of Orchard. Estimated cost: $811,250.

• **Pawnee Pipe Line Co.**—35 miles of 10, 8, and 6-in. line proposed from Adena field in Colorado to Merino, Colo.

Phillips Pipe Line Co.—40 miles of 4 and 6-in. gathering lines under construction in Roberts County, Texas. Brodie Construction Co. is doing the work and expects to finish in April.

Plains Pipe Line Co.—25 miles of 8-in. in South Clareton area and more than 100 miles of 4-in. gathering lines are under way and slated for completion by April 15.

• **Progress Pacific Pipeline Co.**—1,100 miles, 24-in., planned, Odessa, Tex., to Los Angeles, Harbor, Calif.

• **Roosevelt Oil & Refining Corp.**—22 miles, 4 and 6-in., planned St. Helen to Norwich, Mich.

• **Sinclair Pipe Line Co.**—20 miles, 12-16-in., planned, Monee to Blue Island, Ill. Completion date 4-54.

• **Sioux Pipe Line System.**—Under study by Shell Pipe Line Corp. for group of 12 Williston basin producers. Length of line, pipe size, and terminal point pending final report by Shell.

• **West Coast Pipeline Co.**—960 miles, 24-26-in., planned. Wink, Tex., to Norwalk, Calif. $106,000,000.

Products Pipelines

American Pipe Line Co.—Line planned from Gulf Coast area to New York City area.

Badger Pipe Line Co.—215 miles, 8-10-12-in., begin Spring '54, East Chicago, Ind., to Madison, Wis. (Joint project of Cities Service Oil Co., Sinclair Pipe Line Co., Pure Oil Co., and The Texas Co.)

• **H. W. Buss & Sons, Inc.**—152 miles, 4-6-in., proposed. Duval and Live Oak counties, Texas, to Corpus Christi, Tex.

Frontier Ref. Co.—215 miles, 6-in., planned, Cheyenne, Wyo., to North Platte, Neb.

• **Great Lakes Pipe Line Co.**—Planned,

Pipeline Patrol

extension 130 miles, 8-in., Nebraska City to Grand Island, Neb. To start March 1954.

150-miles, 8-in. to run from Iowa City, Iowa to Prophetstown, Ill., and to tie in to the Badger system there.

Harbor Products Systems—86 miles, 16-in., under way, Woodbury Junction, Philadelphia to Linden, N. J. Construction Service Co. and H. C. Price Co. (Joint ownership of Sinclair Pipe Line Co., Gulf Refining Co., and Texas Pipe Line Co.) Completion date May 15.

• **International Pipe Line, Inc.**—132 miles, 8-in., proposed, Wrenshall to Minneapolis, Minn.

Oklahoma Mississippi River Products Line, Inc.—475 miles, 10 and 12-in., under way, Duncan, Okla., to West Memphis, Ark. Ford, Bacon & Davis Const. Corp.

Under way, White River to Allen, Okla. River Const. Co. Completion date 6-30-54.

Under way, Allen to Duncan, Okla. River Constr. Corp. Completion date 6-30-54.

• **Phillips Petroleum Co.**—54 miles, 6-in., planned, Goldsmith to Borger, Tex.

52 miles, 10-in., planned, Shell's Brookshire system to Sweeny, Tex.

Shell Pipe Line Corp.—65 miles of 12-in. products line from Baton Rouge, La., to Shell's Norco refinery. Houston Contracting Co. has contract and expects to start in April if weather and ground conditions are satisfactory.

• **Triangle Pipe Line Co.**—560 miles, proposed, Arkansas City, Ark., to Covington, Ky., and Nashville, Tenn.

U. S. Gov't. Alaskan Products Pipe Line.—600 miles, 8-in., under way, Haines northward through British Columbia and Yukon to Fairbanks, Alaska. Williams Bros., McLaughlin, Inc., and Marwell Const. Co. Completion date 9-55.

Williston Basin Pipe Line Co.—250 miles, 8-in., planned, Laurel-Billings, Mont., refineries to Glendive, Mont.

Wolverine Pipe Line System—200 miles, 14-in., under way, Chicago-Toledo-Detroit. (Joint ownership of Shell, Texas, and Cities Service.) Anderson Bros. and Midwestern Constructors, Inc. Completion date 1-54.

East Chicago, Ind., to Kalamazoo River. Midwestern Constructors, Inc.

Yellowstone Pipe Line Co.—(Continental Oil Co., Interstate Oil Pipe Line Co., Union Oil Co., and H. Earl Clack interest) 540 miles, 10-in., under way, Billings, Mont., to Spokane, Wash. 9-54.

Billings to Bozeman, Mont. Ross and Powers. Comp. July 1954.

Bozeman to Helena and on to Clinton, Mont. Associated Pipe Line Contractors, Inc. Completed.

Clinton to Perma, Mont. Associated Pipe Line Contractors, Inc.

Clinton to Perma, Mont. Eastern Pipe Line Fields Service Co.

Perma, Mont., to Murray, Idaho. Eastern Pipe Line Field Service Co.

Murray, Idaho to Spokane, Wash. Engrs. Limited Pipe Line Co. Total cost: $20,000,000.

Natural-Gas Pipelines

• **American-Louisiana Pipe Line Co.**—1,121 miles of 30 and 22-in., 30-in., proposed, extends from North Tepetate, Acadia Parish, Louisiana, to near Detroit. The 22-in. starts near Payne, Ohio, extends to Bridgman, Mich. Estimated cost: $130,000,000.

• **Associated Natural Gas Co.**—88 miles, proposed, Missouri.

• **Atlantic Seaboard and Virginia Gas Transmission.**—116 miles, 26-in., proposed, loops along Cobb, W. Va., to near Baltimore, Md. Start May 1.

Buzzards Bay Gas Co.—28 miles, 8-in., under way, Hyannis, Mass., to Bourne Bridge, Mass. Hallen Co., Inc. Completion date 4-30-54.

• **Carolina Natural Gas Corp.**—185 miles, 2-12-in., proposed, lateral lines off Transcontinental in North and South Carolina.

Chicago District Pipe Line Co.—19 miles of 36 and 30-in., completed of 35 miles planned. Remainder, all 30-in., will be completed in 1954.

• **Cities Service Gas Co.**—24 miles of 26-in. proposed, to replace two existing 16-in. lines in Franklin and Johnson counties, Kansas.

Nine miles of 20-in. to replace existing 16-in. line in Cherokee and Jasper counties, Missouri.

• **City of Fayette, Ala.**—20 miles, 5-in., proposed, Fayette, Ala., to Southern Natural's system in Tuscaloosa County, Ala.

City of Dallas, Ga.—56 miles of 8 and 4½-in., distribution system. Engineering & Const. Co. Start April 1, 1954.

• **Coast Counties Gas & Electric Co.**—40 miles, 3, 4, and 8-in., planned. Coast and Valley region, California.

• **Colorado Interstate Gas Co.**—365 miles, 22-in., proposed, Green River, Wyo., to Denver, Colo. 1954.

49 miles, 20-in., proposed, Morton County, Kansas, to near Hooker, Okla.

Colorado Interstate Gas Co.—243 miles, 4 to 20-in., under way, Colorado, Oklahoma, Texas, and Kansas. Engineering Const. and Z. J. Graham.

• **Colorado-Western Pipe Line Co.**—454 miles of undetermined size pipe planned between Cortez in Montezuma County and Denver. Line would serve towns of Montrose, Gunnison, Salida, Fairplay and South Platte, Colo. Estimated cost: $30,000,000. Company also plans 254 miles of laterals to service Colo-

Pat. 1,234,567
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WEAR COMPENSATING PIGS

Sizes 6" to 34"

. . . with years of proof that the rugged, simple design means SAFE OPERATION . . . even through pipe lines with sharp bends*

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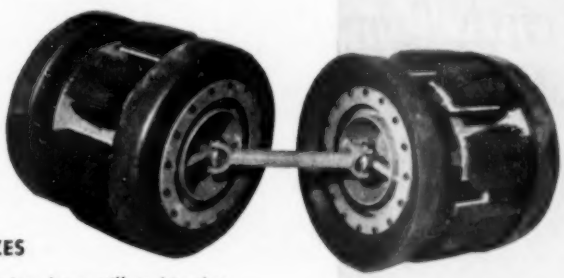

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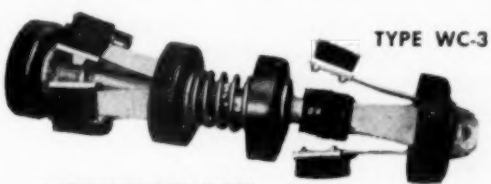
Improved "GP" design: large, stiff steel brushes each expanded by 200-lb. arched spring.

*These 2 jointed Pigs traverse welding ells. Other models traverse all pipeline gate valves.

TYPE WC-3



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Dependable Service Since 1931

Pipeline Patrol

rado cities not now receiving natural gas.

328-mile line, proposed, to run from a point in La Plata County in southwestern Colorado over the Continental Divide along the eastern slope to serve Pueblo, Colorado Springs, and Denver. Estimated cost: $21,600,000.

• **El Paso Natural Gas Co.**—1,178 miles, under way, Permian basin, New Mexico, Texas and Colorado. Spring '54.

El Paso Natural Gas Co.—771 miles, 30 in., under way, Plains, Tex., to Kingman, Ariz.

Section 1—Under way, Plains, Tex., to Corona, N. M. Oklahoma Const. Co.

Section 2—Under way, Corona to Suwanee, N. M. R. H. Fulton.

Section 3—Under way, Suwanee to Gallup, N. M. R. H. Fulton.

Section 4-5—Under way, edge to Navajo Reservation east to Flagstaff on to Kingman, Ariz. Western Pipe Line Const., Inc. Completion date 2-54.

Under way, across Navajo Reservation connecting sections 3, 4, and 5. El Paso Co. crews.

Under way, Spraberry fields, El Paso Co. crews.

• **Fort Worth Basin Gas Co.**—Planned, Novice, through Brown and Comanche counties, Texas.

• **Glacier Gas Co.**—285 miles, 20-in., proposed, Kalispell, Mont., to Spokane, Wash.

120 miles, 16-in., proposed, Spokane to Hanford, Wash.

91 miles, 8⅝-in., proposed, Spokane to Lewiston, Idaho.

130 miles, 12¾-in., proposed, Spokane to International boundary at Trail, British Columbia.

Gulf Interstate Gas Co.—860 miles, 30-in., under way. Acadia Parish, La., to Boyd County, Ky. H. C. Price and Houston Contracting. 11-54.

Houston Contracting Co., Ltd., has completed 370 miles of its 500-mile contract from Rayne, La., to Kinkade, Tenn. Three spreads which have been working on the job are presently overhauling equipment and will not resume work until spring. Spread 1, headed by E. C. Norris, has completed 165 miles from the Mississippi River northward and it will resume work this spring.

Spread 2, headed by F. A. Silar, has completed 117 miles from the Ouachita River southward into the inception point of Rayne.

Spread 3, headed by M. L. Thompson, has completed 88 miles from the Ouachita River northward to the Mississippi River. It will begin work in the spring at the terminus of Kinkade, going south to join with Spread 1.

The remaining 360 miles is under contract to H. C. Price Co., Bartlesville, Okla. The firm has completed 279 miles and has 81 miles remaining which will be started in the spring. Five spreads, headed by G. A. Reutzel, R. L. Ezell, C. E. Shivel, C. R. Ice, and W. H. Olrich, have done the work. Price's contract covered the line between Gordonsburg, Tenn., and Catlettsburg, Ky.

Under way, Rayne, La., to Kincade, Tenn. Houston Contr. 370 miles laid. 130 miles left to be finished Spring of 1954.

Under way, Gordonsburg, Tenn., to Catlettsburg, Ky. 266 miles completed, 91 miles left.

230 miles, gathering lines, under way. Associated Pipe Line Contractors, Anderson Bros., Williams Bros.

329 miles, 12 to 24-in., proposed. Laterals off Acadia Parish, Louisiana, to Boyd County, Kentucky, line.

• **Home Gas Co.**—32 miles, 12-in., planned. Breesport to Union Center, N. Y.

17 miles, 12-in., proposed, loops from Hansock to Sanford, N. M.

Pipeline Patrol

Iroquois Gas Corp. and Tennessee Gas Transmission Co.—Companies planning joint storage project to be known as Colden storage field in New York. The following delivery and gathering lines are planned:

17 miles, 16-in. delivery line.

62 miles, 12, 8, 6, and 4-in. gathering lines.

• **Iroquois Gas Corp.**—25 miles of 20-in. line proposed from Iroquois' Porterville station near Elma, N. Y., to Tonawanda, N. Y.

• **Lateral Gas Pipe Line Co.**—27 miles, 4½ in., proposed, from Grant to Clarinda, Ia. Estimated cost: $267,200.

Lone Star Gas Co.—31 miles of 16-in. under way from Sulphur Springs, Hopkins County, to power plant near Johnstown, Red River County, Texas. Work being done by company forces.

Work will begin this month by company forces on 20 miles of 12-in. from Red Springs, Wood County, to 14-in. line connection in Smith County, Texas.

32 miles of 10¾-in. will start at Barnhart's gasoline plant in Reagan County and connect to applicant's 20-in. line in Upton County, Texas. Estimated cost $798,603.

• **Manufacturers Gas Light & Heat Co.**—40 miles, proposed, Allegheny, Washington, and Beaver counties, Pennsylvania.

213 miles, 3 to 26-in., proposed, various points on system in Pennsylvania, West Virginia, and Ohio.

72 miles, 16-20-in., proposed, Doddridge, Wetzel and Marshall counties, West Virginia.

• **Michigan Consolidated Gas Co.**—25 miles, 12-in., proposed, from near Sparta to Muskegon, Mich.

• **Michigan-Wisconsin Pipe Line Co.**—251 miles, proposed, 24, 18, 12, 6, and 4-in. loops. Majority will be in Illinois.

Missouri Central Gas Co.—25 miles, 6-in., proposed, Moberly to Macon, Mo.

• **Missouri Public Service Co.**—136 miles, 8-10-in., proposed, New Franklin to Trenton, Mo.

24 miles, 10-in., Johnson County to Clinton, Mo.

• **Natural Gas Producer, Inc.**—100 miles, 12-in., planned, Yenter pool to Denver, Colo.

• **New River Gas Co.**—50 miles, planned, Summers to Monroe counties, West Virginia, to Narrows and Dublin, W. Va.

• **North Dakota Gas Transmission Co.**—470-mile line from Tioga plant of Signal Oil & Gas Co. and Beaver Lodge field to Fargo and Grand Forks, N. D. Line will have 78 miles of 12-in., 215 miles of 10-in., 70 miles of 8-in., and 107 miles of 6-in. Estimated cost: $10,800,000.

• **Northern Indiana Fuel & Light Co.**—35 miles, 8-in., planned, Edgerton to Auburn, Ind.

• **Northern Natural Gas Co.**—Company planning 359 miles of lines for 1954; 200 miles will be main line, 139 miles will be branch lines, and 20 miles will be gathering lines. Pipe size and areas, not announced yet. Est. cost: $38,000,000.

• **Northwest Alabama Gas District**—40 miles, 9-in., proposed, Southern Natural's line through Windfield to Haleyville, Ala.

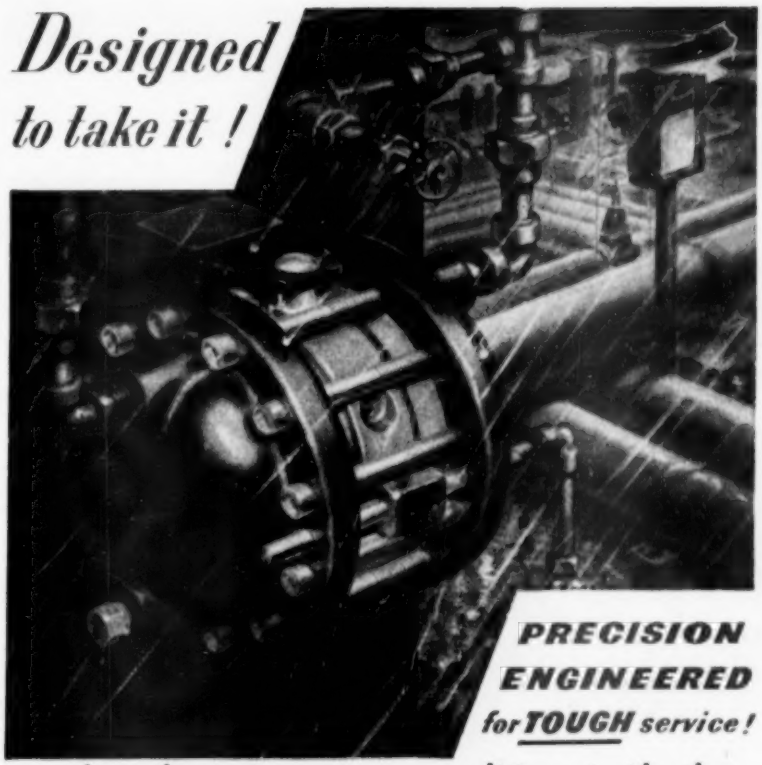
Northwest Natural Gas Co.—665 miles of unannounced size pipe to bring gas from Alberta, Canada, to the "Inland Empire" of northern Idaho and eastern Washington. Estimated cost: $36,000,000.

• **Ohio Fuel Gas Co.**—31 miles, 20-in., planned, Licking County to Richland County, Ohio.

22 miles, 16-in., planned, Dayton, Troy, Piqua, and Sidney, Ohio.

23 miles, 16-20-in., planned, Wellington to Elyria, Ohio; 16 miles, 20-in., planned, Benton Station to Crawford Station; 18 miles, 20-in., Crawford Station to near Columbus;

Designed to take it!



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SAFETY ADVANTAGE: Barton patented bellows . . . truly rupture-proof.

ECONOMY GAIN: Economy through simplicity of maintenance.

ACCURACY FEATURES: Temperature compensation, frictionless and leak-proof Torque-Tube Drive.

EFFICIENCY: Externally adjustable internal pulsation dampener.

VERSATILITY: Precision levelling not needed, portable or permanent installation, stainless steel for chemical usage, dial graduations to fit your needs.

BARTON *welcomes your inquiries on flow metering problems. Our staff of specially trained sales engineers are ready to help you.*

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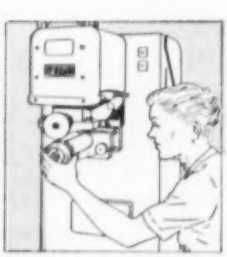


Send for Bulletin 11C4 or contact our local sales representatives.

BARTON INSTRUMENT CORPORATION
INDUSTRIAL INSTRUMENTS
1429 SOUTH EASTERN AVENUE • LOS ANGELES 22, CALIFORNIA

Pipeline Patrol

16 miles, 16-in., planned, Berlin to Sandusky, Ohio.

74 miles, 3 to 20-in., planned, Hocking, Knox, and Ashland counties, Ohio.

47 miles, 20-in., planned, Benton Township, Hocking County, to Columbus, Ohio.

61 miles, planned, northern and southwestern Ohio.

33 miles, 20-in., proposed, Jefferson to Seneca, Ohio.

69 miles, 20-24-in., proposed, lines to tiein Gulf Interstate line along various points in Lawrence, Jackson, Vinton, Hocking and Fairfield counties, Ohio.

Pacific Gas & Electric Co.—200 miles, 34-in., planned, paralleling Topock-Milpitas line. 107 miles contracted to Engineers Limited Pipe Line Co. L. E. Robertson is in charge of the spread handling work from Newberry to Danby and from Los Muertos Creek to Gilroy, Calif.

15 miles, 20-in., planned for completion in 1955 from Helm Tap to Helm Junction, Calif. Alex Robertson Co.

15 miles, 12-in., planned for completion in 1955. From Herndon to Madera, Calif. Company forces.

13 miles, 16-in., scheduled for completion in 1954. From Fairfield to Napa Wye, Calif. M.G.M. Construction Co.

30 miles, 10-in., scheduled for completion in 1954. From Corning field to Chico, Calif. Company forces.

19 miles, 16-in., from Wild Goose field to Yuba City, Calif. Scheduled for 1954 completion by company forces.

• **Pacific Northwest Pipeline Corp.**—1,466 miles, proposed, Ignacio, Colo., to Bellingham, Wash.

380 miles, proposed, laterals and spurs off main line to Pocatello, Idaho, to Yakima, Wash.

• **Pine Tree Natural Gas Co.**—204 miles of undetermined size pipe to run from the Boston area to Bangor, Me.

• **Shenandoah Gas Co.**—40 miles, 3-4-8-in., proposed, Middleton, Va., to Martinsburg, W. Va. Est. cost: $1,470,000.

• **South Georgia Natural Gas Co.**—339 miles, 2-12-in., planned, Phoenix, Ala., to Tallahassee, Fla. (a) 12-in., Phoenix, Ala., to Albany, Ga., (b) 10-in., Albany, Ga., to Moultrie, Ga., (c) 8-in., Moultrie, Ga., to Tallahassee.

• **Southeast Alabama Gas District.**—150 miles, 10 and 8-in., planned, Phoenix City to Dothan, Ala. Engineering Const. Co. Start April 1, 1954.

• **Tennessee Gas Transmission Co.**—574 miles, 30-in., planned, Kinder, La., to Portland, Tenn.

63 miles, 26-in., planned, loops in Ohio and Pennsylvania.

45 miles, 20-in., proposed, Buffalo, N. Y., to the U.S.-Canadian border near St. Catherines.

243 miles 24-in., planned, Coudersport, Pa., eastward across Pennsylvania, New Jersey, and New York to point near Greenwich, Conn.

• **Texas Eastern Penn-Jersey Transmission Corp.**—265 miles 24-in., planned, from Oakford Storage field in western Pennsylvania to Texas Eastern Transmission Corp.'s Compressor Station No. 26 near Lambertville, N. J. Estimated cost $30,755,000.

• **Texas Gas Transmission Corp.**—48 miles, 26-in., planned, loops from Memphis to Slaughters, Ky.

24 miles, 16-in. line proposed from North Tepetate field, Acadia Parish, Louisiana, to South Roanoke field in Jefferson Davis Parish, Louisiana.

• **Texas-Ohio Gas Co.**—1,435 miles, 30-in., proposed, Hidalgo County, Texas, through Arkansas, Mississippi, Tennessee, and Kentucky on to Spencer, W. Va.

• **Transcontinental Gas Pipe Line Corp.**—421 miles, 30-36-in., looping along Texas-New York line.

19 miles of 12.75-in. pipe starting at West White Lake field in Vermilion Parish, Louisiana, and connecting with applicant's transmission line in same parish. Estimated cost: $1,042,310.

• **Trans-Northwest Gas, Inc.**—246 miles, proposed, International Boundary near Osoyoos, B. C., to Washington and Idaho.

275 miles, branch lines.

United Gas Fuel Co., and Central Kentucky Natural Gas Co.—57 miles contracted, to Putnam County, West Virginia. H. C. Price Co.

• **United Fuel Gas Co.**—52 miles, 20-24-in., proposed, Wood County to Lanham, W. Va. Spring 1954.

57 miles, 30-in., proposed, Lanham in Kanawha County, West Virginia, to Gulf Interstate line in Boyd County, Kentucky. Spring '54.

United Gas Pipe Line Co.—44 miles, 20-in., under way, Lirette field to Harvey, La. Brown & Root.

Utah Natural Gas Co.—63.7 miles of 18-in. line completed by R. H. Fulton Co. from Clear Creek field to Orem, Utah.

40 miles from Orem to Salt Lake City will be built of 16-in. pipe at later date. Contract not let yet.

Virginia Natural Gas Co.—153 miles, Buckingham to Richmond and Portsmouth, Va.

Warren Pipe Line Co.—25 miles of 3-20-in. being laid in Garvin County, Oklahoma, by George W. Davis Co. Completion date not set.

Westcoast Transmission Co., Ltd. — (See foreign natural gas pipe lines).

Foreign Crude-Oil Pipelines

• **Arabian American Oil Co.**—18 miles, 22-20-in., planned, Qatif to Ras Tanura No. 3. Completion date 1-55.

Bombay Port Trust.—50 miles, 8 to 24-in., contracted, Bombay, India, to serve Standard Vacuum Oil Co., and Burmah Shell refineries. Merritt, Chapman & Scott Corp., contractors. (Crude and Products.)

Creole Petroleum Corp.—21 miles, 34-in. crude line to run from Lagunillas field to La Salina, Venezuela. Williams Brothers Overseas Co. has contract with construction slated to start in February and to be completed in 6 months. Line when completed will be the world's largest-diameter crude line.

Direccion General de Yacimientos Petroliferos Fiscales—409 miles, under way, Plaza Huincul to Bahia Blanca, Argentina.

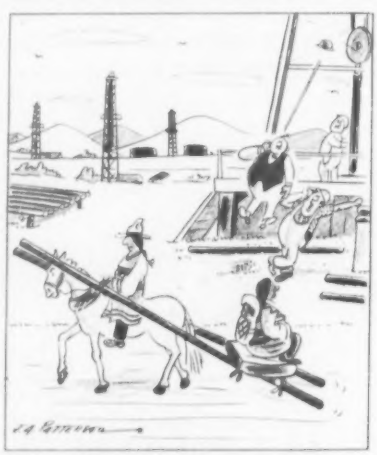
Estrada De Ferro Santos A Jundiai Oleoduto Santos—Sao Paulo.—This Brazilian company has completed or recently started the following lines:

2 miles, 24-in. crude line from Junction to Refinery at Capuava. Completion, May 1954.

21 miles, 12-in., planned from Cubatao to Capuava refinery. Completion scheduled for June 1954.

8 miles, 18-in., planned from Junction to power plant at Cubatao. Completion set for March 1954.

6 miles, 8-in., products line, planned from Capuava refinery to Utinga. Completion set for March 1954.



"When he asked me for a couple of old pipes, I never dreamed what for."

• **Gaz de France**—200 miles, 12-in. Ruhr to Paris, France.

• **Interprovincial Pipe Line Co.**—600 miles 24 and 26-in. loops, planned, along Interprovincial system between Edmonton, Alta., and Superior, Wis.

• **Mid-Saskatchewan Pipelines, Ltd.**—Proposed line from Smiley Viking oil field to connect with Interprovincial Pipe Line Co.'s Kerrobert pump station.

• **Petroleos Mexicanos.**—145 miles, 12-in., considered, 18 de Marzo field via Reynosa to Monterrey, Mexico.

100 miles, planned, Ishthmus of Tehuantepec, Jose Colomo to El Plan field, Minatitlan.

72 miles, 12-in., proposed, Poza Rica to Atzacapotzalco, Mexico.

Petroleos Mexicanos.—125 miles, 10-in., under way, Jose Colomo to El Plan, Mexico.

• **Saskatoon Pipe Line, Ltd.**—56 miles, 6-in., planned, Milden to Saskatoon, Sask.

Texas Petroleum Co. — 60 miles, 4-6-in., under way. Pta. Nino de La Dorada.

• **Trans Mountain Oil Pipe Line Co.**—30 miles, 20-in. from Vancouver to General Petroleum's refinery under construction at Ferndale, Wash.

20-in. line planned from Ferndale to Burlington and a 16-in. line planned to Shell Oil Co.'s refinery under construction at Anacortes, Wash.

• **Yacimientos Petroliferos Fiscales Bolivianos.**—170 miles, 4-in., planned, Bermejo to Tupiza, Bolivia.

Foreign Products Pipelines

Anglo-Iranian Oil Co., Ltd.—18½ miles, 16-in., under way, Little Aden to Aden. Bechtel Corp. Completion date December 1954.

18½ miles, 6-in., under way, Little Aden to Aden. Bechtel Corp. Completion date December 1954.

15 miles, 12-in., under way, Kwinana to Fremantle, M. W. Kellogg Co. Completion date February 1955.

17 miles, 6-in., Kwinana to Fremantle. M. W. Kellogg Co. Completion date February 1955.

• **Empresa Nacional del Petroleo** — 80 miles, 6⅝-in., planned, Concon to Santiago, Chile.

• **Governments of Southern Rhodesia and Portuguese East Africa.**—200 miles, considered, Beria, Portuguese Mozambique to Umtalia, Southern Rhodesia.

North Atlantic Treaty Organization (NATO)—1,920 miles, 4-10-in., to serve military bases in Western Europe (to connect with U. S. Government's St. Nazaire-Paris-Metz line.) Contracted by Soc. Foster Wheeler Francaise.

• **Petroleos Mexicanos.**—124 miles, 6-in., planned, Lagos to Guadalajara, Mexico.

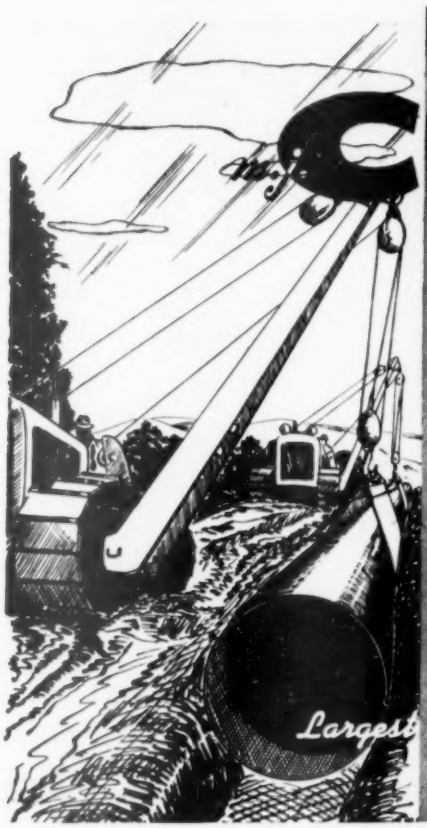
54 miles, 6-in., planned, Lagos to Aguascalientes, Mexico.

82 miles, 8-in., planned, Salamanca to Lagos, Mexico.

• **United States Government.**—375 miles, 12-in., planned, St. Nazaire to Melun and Metz, France.

Foreign Natural-Gas Pipelines

Azienda Generale Italiana Petroli — 90 miles, 12-in., under way, Cortemaggiore to Bologna, Italy, SNAM crews.



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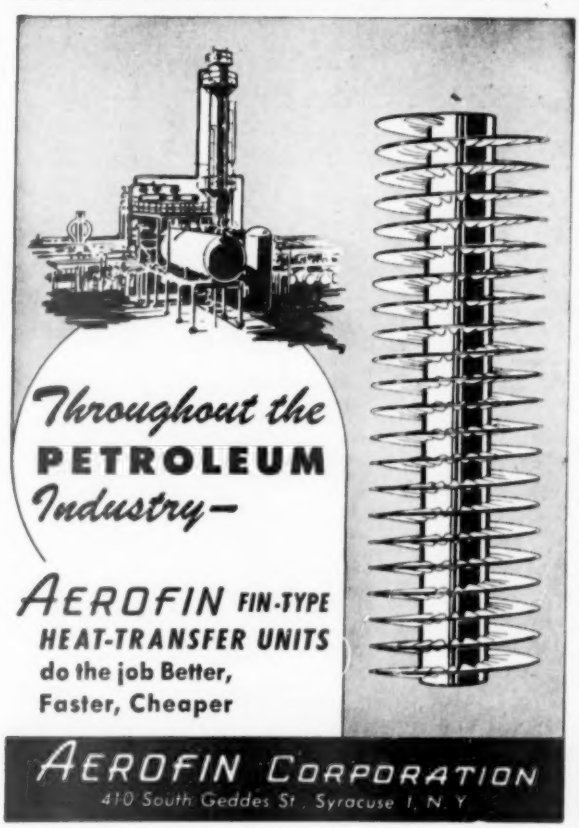

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410 South Geddes St., Syracuse 1, N. Y.

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A low-cost way to prevent high-priced fires

How to select the proper *Safety Tool*

For tools with cutting edges or gripping teeth—specify Ampco beryllium Copper Tools.

For jobs in the vicinity of acetylene and similar gases — specify Ampco Monel† Tools.

For tools subject to impact and/or torque specify tools of Ampco Metal.

ALL fires are costly—in property damage, in lowered employee morale, in interrupted production. And the best way to fight a fire is not to let it start. That's why a small investment pays off in real fire protection, when you provide Ampco Safety Tools for use in hazardous locations.

Ampco Safety Tools are approved and recommended by Factory Mutual Laboratories and other leading safety authorities for use wherever there's a special fire hazard—spray booths, paint lockers, gasoline-storage areas, etc.

The Ampco Safety Tool line is the largest available anywhere. From more than 400 items select the right tool for practically every one of your jobs. Order today — to take advantage of reduced insurance rates and greater employee safety.

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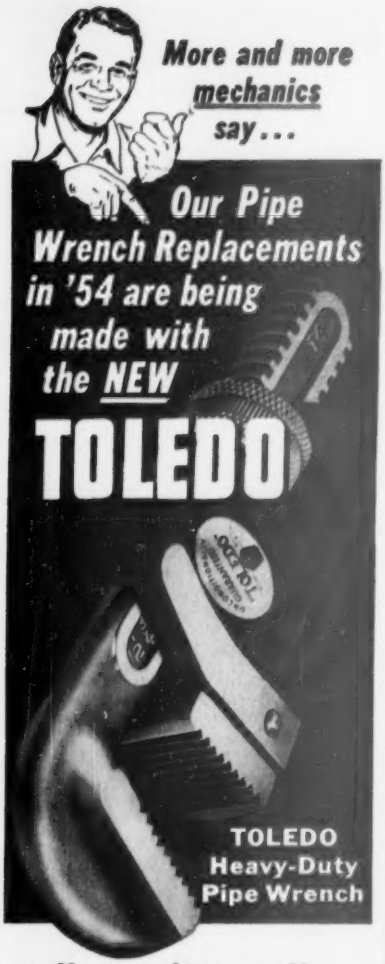
West of the Rockies, it's Ampco Burbank Plant, Burbank, Calif.

In Canada, Safety Supply Co., Toronto, Ontario

†T. M. International Nickel Co. *Reg. U. S. Pat. Off. T-9A



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Just introduced — and making friends fast! See 'em—try 'em on your next job!

New Toledo Wrenches speed the work with easy handling . . . instant non-slip grip on pipe . . . replaceable jaws with spin-easy nut and single spring for quicker, easier setting . . . improved handle design for increased strength, better hand-grip. 6" to 48" sizes.

Unconditionally Guaranteed! If wrench housing or hook ever breaks or distorts, we will replace it Free. Write for new catalog. Order through your supply house. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

Rely on the Leader . . . *all the way!*

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PIPE TOOLS • POWER PIPE MACHINES • POWER DRIVES

Pipeline Patrol

120 miles, 16-in., under way, Cremona Porto Mar to Ghera, Italy, Montubi, contractor.

40 miles, 12-in., under way, Ripalta-Bergamo, Italy.

Direccion General del Gas del Estado—310 miles, 8-in., under way, Plaza Huincul to Neuquen, Argentina, to the vicinity of General Conesa, Argentina.

• **Empresa Nacional del Petroleo** — 80 miles, 10-in., planned, Concon to Santiago, Chile.

• **Northwest Natural Gas Co.**—950 miles, 24-in., planned, Alberta fields to Vancouver, B. C., Seattle, Wash., and Portland, Ore.

Petroleos Mexicanos. — 205 miles, 16-in., under way, Monterrey to Torreon, Mexico.

• **Petroleos Mexicanos.**—440 miles, 20-in., planned, Brazil to Tampico to Poza Rica, Mexico.

Societa Nazioaule Metanodotti.—This Italian company has completed or has the following projects under way. All completed jobs were finished January 1954.

53 miles, 16-in., Cremona to Porto Marghera. Montubi, Contractor. Completion May 1954.

72 miles, 16-in., Cortemaggiore to Genova. Montubi, contractor. Completion February 1954.

35 miles, 16-in., Cremona to Busto Arisizio. Sartori-Mereco-Bomar, contractors. Completion April 1954.

• **Tennessee Gas Transmission**—75 miles of undetermined size pipe proposed from Buffalo to Toronto. Proposal passed Canadian Senate will go before parliament probably in April 1954.

• **Trans-Canada Pipe Lines, Ltd., (Canadian Delhi Oil Co.)**—2,247 miles, 14 to 30-in., proposed, Alberta to Toronto to Montreal.

747 miles, 8 to 24-in., gathering system in Alberta.

• **Union Gas Co. of Canada, Ltd.**—Proposed line from Lambton County gas-storage fields to Oakville. Line is being proposed now and will eventually join with proposed line from Alberta to Toronto and Montreal.

• **Westcoast Transmission Co., Ltd.**—932 miles, 24-in., planned, Ft. Saint John, B. C., to Spokane, Seattle, and Portland. Ford, Bacon & Davis, Engineers.

138 miles, 20-in., planned, Sumas to Tacoma, Wash.

139 miles, 18-in., planned, Tacoma, Wash., to Portland, Ore.

• **Western Pipe Lines.**—833 miles, 24-in., proposed, from southern Alberta, eastward across the Canadian prairies, serving principal towns and cities along the route.

"Remember, Pet, you were in the right."

McFARLAND

DOUBLE POWERED HYDROSTATIC TESTING PUMP

Rental!

Two-Stage, double-acting, reciprocating pumps operated by air, water, gas or other fluids under pressure. Discharge to input pressures range from 200/1 down 20/1. Large discharge capacity and instant build-up of pressures saves hours of testing time. Ideal for operating blowout preventers, for testing valves, pipe, fittings, pipe lines, tanks, boilers and other pressure vessels.

Write for rental rates on testing pump you need.

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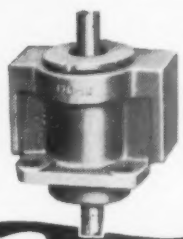

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No. 176-1B Lubricating Cap

Working together, the Ratigan Lubricating Cap and the Ratigan Stuffing Box make an efficient combination providing the polished rod with continuous lubrication . . . the lubricating cap when the flow of oil in the tubing is retarded, and the self-oiling stuffing box when the well is not heading. The lubricating cap provides longer wear of the packing rubbers and more economical operation of the stuffing box.

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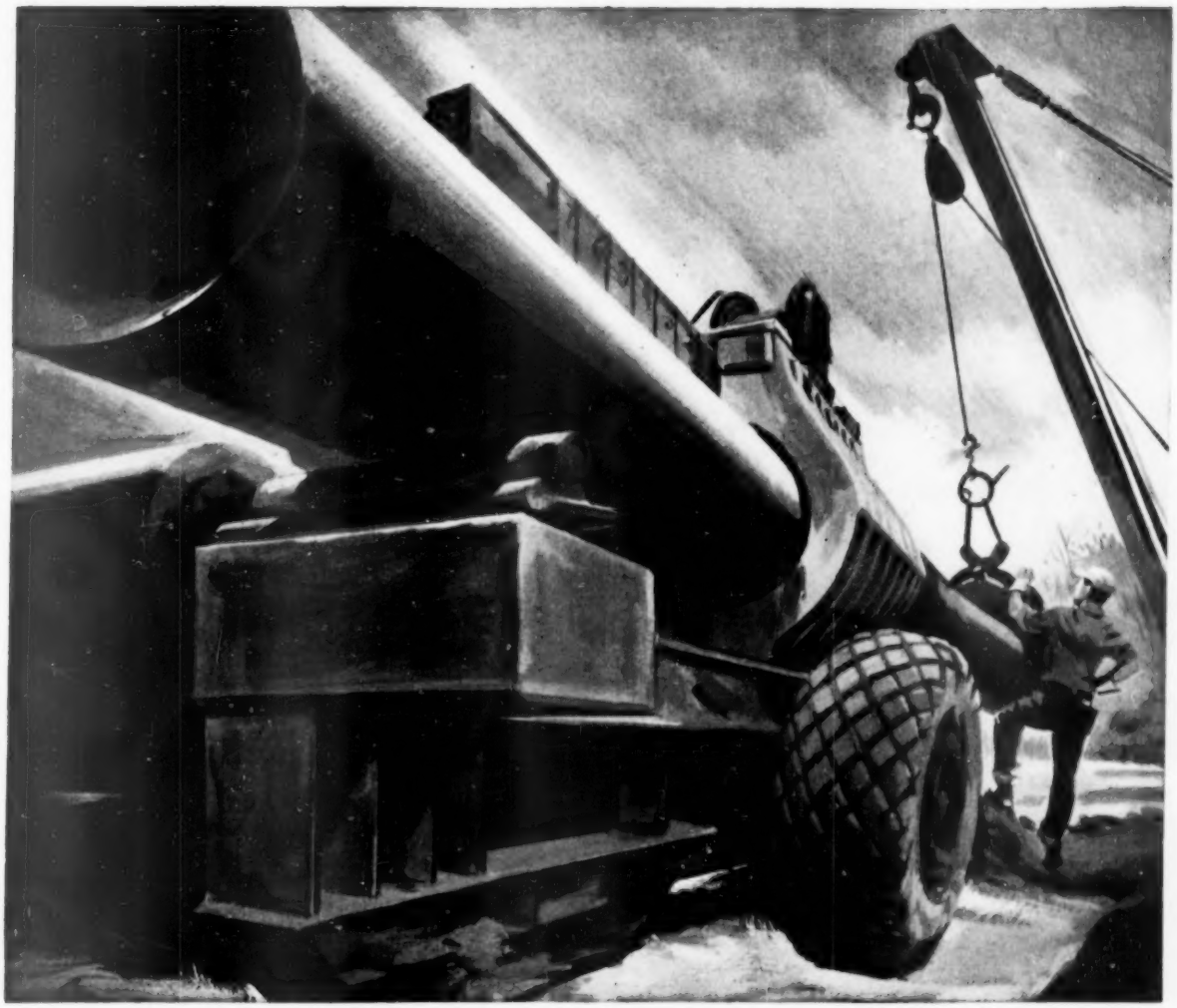

"on a big bender"

The section of steel pipe shown above is on "a big bender" . . . the machine illustrated is putting a custom-made bend in the pipe to fit a curved section of the trench. It saves a lot of work and expense by taking care of tough angles right on the job.

This section of pipe, like every other part of this pipeline, will be treated with a Barrett Coal-Tar Protective Coating to provide long-lasting protection. Barrett high-quality protective coatings cover all the angles of pipeline construction, too — rough terrain, tough handling, and nasty weather conditions. It's an interesting fact that these top-quality protective coatings while they lengthen the life of steel pipeline indefinitely, increase the cost by only the smallest fraction. And when you specify Barrett you are getting the finest protective coatings plus expert technical assistance.

The Barrett Technical Service Group assists you right from the blueprint stage. They help you select the coating for your pipeline which provides top protection at minimum cost. In the field, Barrett Service Representatives are always ready for on the spot check-ups, advice and assistance with the preparation of pipe and application of coating. We welcome the opportunity to place the Barrett Technical Service Group at *your* service. For detailed information — phone, write, or wire Barrett.

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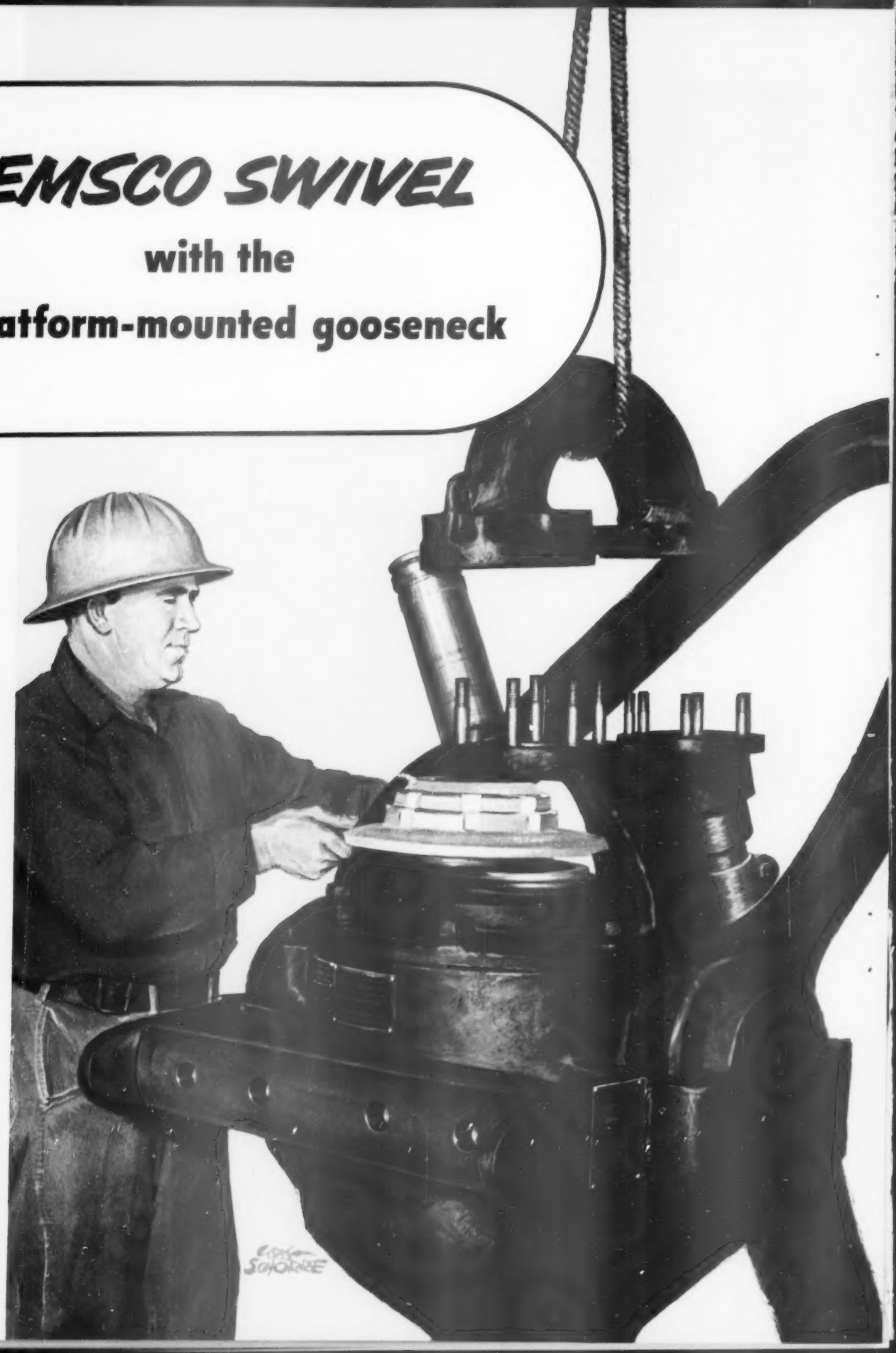
with the

platform-mounted gooseneck



FOR SHALLOW TO DEEPEST DRILLING

You get important time-saving, labor-saving features in the new Emsco L-Series swivels with the platform-mounted gooseneck . . .

L-Series swivels range in dead load capacity from 140 to 400 tons. All sizes are identical in design. Lighter than former models of like capacity, they reduce the danger of the kelly being bent in the rat hole. Height has been lowered and hook clearance increased. Other features include low center of gravity, high capacity main bearing, that can be adjusted without going into the body of the swivel, replaceable bail pins, and replaceable sub.

Platform-mounting of the gooseneck permits it to be lifted off without disturbing the rotary hose connection. This greatly reduces the time required to replace washpipe and packing. Sturdy construction of the gooseneck platform prevents misalignment of the washpipe.

ONE-PIECE CARTRIDGE PACKING CUTS DOWNTIME

Emsco's one-piece cartridge packing greatly increases the life of the washpipe and packing assembly. The packing is made of five lip-type sealing rings. The top serves as a grease seal, assuring proper lubrication of the unit. The bottom four rings seal against highest mud pressures.

Only one of the soft, flexible rings is in contact with the washpipe at a time. As each lip wears, the sealing function passes to the next higher lip. The service life of packing and washpipe are increased many times by this feature.

Call CONTINENTAL for details about the rugged highly economical L-Series swivels.

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E 164

No Seat Leakage Through This Valve ...on Hot Wax Service, for instance

In the wax unit of a leading Gulf Coast lube oil plant, with Crane Steel Gate Valves in hot wax lines to slabbing machines.

VALVE SERVICE RATINGS

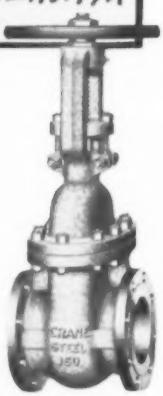
SUITABILITY:	Best for the job
FEATURES:	Outstanding Exelloy trim
MAINTENANCE COST:	Routine care only
SERVICE LIFE:	Good as new—after more than 2 yrs.
OPERATING RESULT:	No production lost to valve trouble
AVAILABILITY:	Regular Catalog item—No. 47X

THE CASE HISTORY

The steel valves originally installed here were hindering maximum wax production. The chilling cycle was slow—rejects for remelting were high. The trouble was that the shutoff valves were leaking, and hot wax was getting into the presses during the chilling cycle. Yet the valves were comparatively new.

There's been no such trouble since Crane No. 47X, 150-Pound Gates were installed more than 2 years ago. Their Crane Exelloy trim, suited for temperatures up to 1000 deg. F. keeps giving a tight shutoff on the hot wax, month after month, with easy operation. And they've done so with but routine attention, ever since installed. Better quality is always the bigger value, as every thrifty valve buyer knows.

THE VALVE



Workhorse of the petroleum industry—Crane 150-Pound Steel Gates—with exceptional performance assured by Crane quality design—Crane pioneering in steel casting—and the high adaptability of Crane Exelloy trim for most petroleum services. Sizes 2 to 24 in.; screwed, flanged, welding ends. See your Crane Catalog or your Crane Representative.

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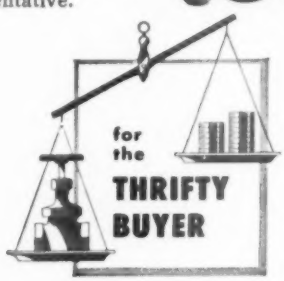

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Your inquiry will be forwarded to the supplier within 48 hours (or less) from the time we receive it.

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. . . What's New in Equipment?

Use the handy Time-Saver Cards ✓✓✓ to obtain additional information on these items

by Dan B. Miller

Gooseneck Boom Optional on 4-Ton Crane

New in the truck-crane field, a hydraulically operated gooseneck boom, is now available as an optional accessory on the Model 80, four-ton truck crane. The crane is designed so that a trailer can be pulled by the same truck on which the crane is mounted. The crane can be used to load directly onto and off of this trailer.

With the new gooseneck-type boom, the operator can fold the boom down over a loaded trailer by pushing a lever at his regular operating station, and be ready for road travel in seconds. When the new gooseneck boom is unfolded for work, it has the same strength and capacity as the standard boom.

The goosenecking operation is accomplished with a hydraulic cylinder installed in a V-shaped opening about 4½ ft. from the base of the boom. The folding unit is designed so that the stress in the boom resulting from a load is not on the hydraulic cylinder, but on the heavy steel bar and pin which form the basic structure of the folding mechanism. *Pitman Manufacturing Co.*

Check No. 1 On The Time Saver Card

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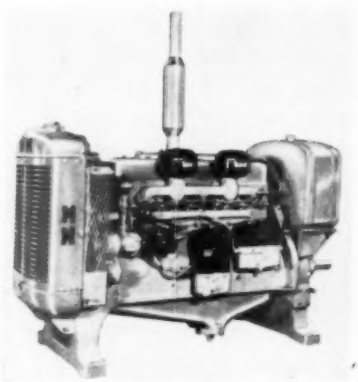

Diesel Power Engines Use Energy Cell Combustion

Latest diesel developments are incorporated in these new, popular-sized diesel power units. Both the D283-4 4-cylinder and D425-6 6-cylinder diesel units have a 4¼-in. bore, a 5-in. stroke, and feature energy cell combustion.

By using the energy cell this design reduces fuel consumption, and obtains cleaner exhaust and longer engine life. American Bosch simplified single-plunger fuel-injection system, an improved package water pump, and two water coolant nozzles for each fuel-injector nozzle, are also incorporated in the design.

Cylinder blocks are cast in pairs, and are removable from the crankcase. A heavy, rigid-cast base pan is flanged and bolted to the flywheel housing. Heavy-duty aluminum alloy pistons are cam-ground and tin-plated. Liberal size of crankshaft journals, and large bearing areas supply an extra margin of dependability for continuous heavy-load operation. A three-stage fuel-filter unit and large capacity oil filters are further assurance of trouble-free operation. *Minneapolis-Moline Co.*

Check No. 2 On The Time Saver Card

Extruded Pipe Offers New Solution for Steam Tracing

Users of steam-traced piping have a totally new solution to their equipment problems in Unitrace, an integrally extruded steam-traced aluminum pipe. Piping users who handle sluggish products need heated lines to prevent products from solidifying or crystallizing in the line. Unitrace is so produced that the steam line is an integral part of the pipe.

Extruded as a single unit from Alcoa 3S-F aluminum alloy, the new product is slightly oval in cross-section because of the crescent-shaped steam passage adjacent to the product line. The size now available has the pipe dimensions of 2 in., schedule 40 pipe.

In one installation, Unitrace resulted in the following savings over conventional 2-in. steam-jacket lines: 38 cents

a foot saved on material; 5 cents a foot saved on insulation; and 30 per cent reduction in labor costs.

Unitrace exhibits greatly improved heat-transfer properties over normal steam tracing techniques. Pre-formed insulation will fit Unitrace. In the case of the 2-in. standard pipe, the new product is designed so that insulation for 2½-in. standard pipe will form naturally. Because of improved efficiency, thermal insulation will be unnecessary in many cases, particularly where set quantities of process steam are allocated

40-ton workhorse

TYPE D218
DOUBLE SHEAVE
WEIGHT 760 LBS.

TYPE D118
SINGLE SHEAVE
WEIGHT 550 LBS.

GUIBERSON Type D Tubing Block with Swivel Becket

Built short and compact, the Guiberson Type D tubing block with swivel becket falls fast and won't foul up. This block has 18″ sheaves with heavy duty cylindrical roller bearings. It is equipped with a swivel becket with heavy duty tapered roller thrust bearings.

The top-opening becket link is permanently pinned at bottom. Becket opening is 6½″ x 9½″ and will accommodate up through 2¾″ links. Sheaves are grooved for ⅞″ or ¾″ wire line.

Priced right and built right, the Guiberson Type D block and swivel becket is rated at 40 tons, with a factor of safety 3 to 1 on yield point. Well within API specifications. Maximum height with becket 55¼″, maximum width 20″. Thickness, double sheave 9⅝″, single sheave 7″.

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CORPORATION
ESTABLISHED 1919 • DALLAS, TEXAS, U. S. A.
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for tracing purposes. *Aluminum Co. of America.*

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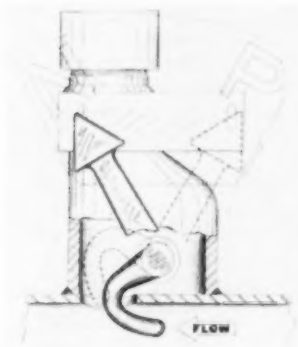


Pig-Sig Indicates Passage Of Pipeline Scraper

The Pig-Sig is a device to attach to pipelines larger than 4 in. to indicate the passage of the pipeline scraper. This signal is welded to the line and the trigger hole is tapped under pressure. A plug is then installed and the 2-in. tapping valve is removed, all without shutdown of the pipeline. Upon completion of this installation, the Pig-Sig can be equipped with a visual signal on either or both sides, an explosion-proof micro switch for hand reset, or similar switch and automatic reset.

The unit is a safety device which will save shutdown time by positively indicating the arrival or departure of the Pig or automatically shutting down and restarting booster stations for scraper passage. Other applications include remote actuation of valves, checking batch movements, gaging by line displacement, and launching new Pigs upon arrival of worn ones. *T. D. Williamson, Inc.*

Check No. 4 On The Time Saver Card

●

McCullough Adds to Bridge Plug Line

Twelve new additions have been made to McCullough Type B bridge plug line, increasing the total sizes available from 25 to 37. The new additions include a range of smaller sizes for use in tubing and drill pipe, starting with a 1¾-in.-o.d. plug for 2-in. tubing, and larger sizes ending with a 10½-in.-o.d. plug for 11¾-in. casing and open hole.

The new small plugs have all the features and advantages of the larger sizes, and have been tested to 13,000 psi. differential hydrostatic pressure.

The McCullough Type B bridge plug is one-piece, all metal, drillable, and operates on explosion-expansion principle. It has no moving parts, which speeds drilling out and simplies setting. *McCullough Tool Co.*

Check No. 5 On The Time Saver Card

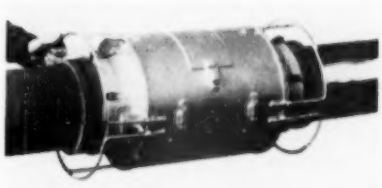
●

Panel Needle Valve Can Be Installed in Seconds

The PM series, a new, easy-to-install panel-mounted needle valve is designed to save both time and money. It can be installed in seconds. The loosened packing nut and first holding nut are easily removed and the threaded stem guide can then be slipped through the panel opening. The first packing nut is then replaced and adjusted in relation to the second packing nut, firmly mounting the valve in the panel. Assembly is completed with the addition of the packing nut and valve handle.

All PM series needle valves are machined from extra heavy bar stock steel, and are designed for a maximum working pressure of 10,000 psi. for use on water, oil, or gas. The valve stem is machined with fine pitch threads to permit close throttling. Marpak is used to produce a leak tight seal around the valve stem without binding, permitting easy operation of the valve at all times. *Jas. P. Marsh Corp.*

Check No. 6 On The Time Saver Card



Roskoter Provides Uniform Distribution of Coating

Roskoter, a new pipeline coating device, is a hollow cylinder which can be fitted around any size pipe up to 12 in. Interchangeable coating shoes lined with heavy-duty carpets are secured to each end of this cylinder. Adjustable draw-bands control film thickness of the coating.

Recent field tests show that Roskoter reduces man-hours involved in pipe coating up to 80 per cent, with a resulting saving of at least 50 per cent in over-all costs.

While reducing labor application costs, it provides a smooth, uniformly distributed coating around the entire pipe circumference, thus assuring coverage of the pipe bottom. No mastic is spilled or otherwise wasted. Roskoter carpets last eight times as long as brushes and are easily removed and replaced.

One man can operate the Roskoter on smaller pipe, and only two are needed on pipe up to 12 in. It is easily filled and emptied through a large trap on top of the cylinder. No other equipment is needed. It is available in three sizes: small, medium, and large. Each size unit can be fitted with coating shoes for different diameters of pipe. *Royston Laboratories, Inc.*

Check No. 7 On The Time Saver Card

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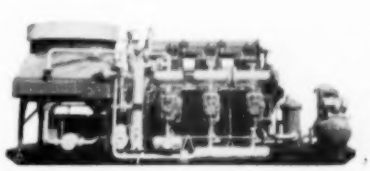

Packaged Compressor Units Are Individually Designed

Packaged gas engine-driven compressor plants are complete, portable, skid-mounted units for gas lift, gas booster, pressure maintenance, and similar projects. The plants are individually designed and constructed to meet the par-

ticular requirement of each installation.

The unit is a complete compressor plant, fully factory assembled and mounted on a portable, heavy-duty skid base. Cooling, air-starting, lubricating, scrubbing, and automatic control systems with complete piping are installed and ready for unattended field operation.

The heart of the plant is the Cooper-Bessemer GMX, V-angle gas engine-driven compressor unit. Built in four, six, and eight-cylinder sizes, there is a GMX available to meet precisely any power requirements from 220 to 500 hp. Positive starting is assured by a simple air-starting system, using a Wisconsin engine for compressor power. Fin-tube cooling coils of aluminum alloy bonded to an admiralty metal inner tube can be easily cleaned or replaced. Vane type mist extractors are standard equipment. *Southwest Steel Plate Division.*

Check No. 8 On The Time Saver Card

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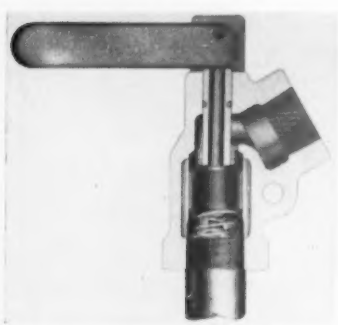

New Air Valve Offers Positive Shutoff

A new Type TA-30 air valve is designed for use as a positive shutoff valve at the point where the hose leading to any air powered tool is connected to the main air line.

When open, the valve gives unrestricted flow to the tool. When closed, air is automatically bled out of the tool so the hose can be safely disconnected from the outlet of the valve.

Illustrated here in the open position, the cam-type handle causes the stem to hold the poppet off the seat and allows free air flow through the valve. The stem is hollow, but pressure of the poppet against the end of the stem prevents leakage through the stem. When closed, by simply shifting the handle to point downward, the stem allows the poppet to seat and shut off the flow. Air in the hose and in the tool bleeds out through the hollow stem. *Cameron Iron Works.*

Check No. 9 On The Time Saver Card

●

New Engine Offers High Power for Displacement

A new 172-cu. in., 4-cylinder industrial engine develops 61 b.hp. at 2,800 r.p.m. Less displacement normally requires less gas, which means greater daily operating economy.

The large 3.90-in. bore of the new engine is combined with a short 3.60-in. stroke to cut piston travel, friction, and fuel costs. A deep-skirt crankcase provides greater rigidity, and the precision-molded alloy-iron crankshaft is fully balanced in motion before installation in the engine.

Free-turn intake and exhaust valves permit even wear, and help maintain high compression for longer than average, as well as reducing the possibility of sticking valves. Ignition and distributor are sealed against moisture and dust. The engine has a full-flow oil filter with full-pressure lubrication. *Ford Division, Ford Motor Co.*

Check No. 10 On The Time Saver Card

●

Gravity Correction Table Saves Time, Inaccuracy

Direct-Reading A.S.T.M.-I.P. Basis, Gravity Correction Table, with proportional interpolation for each tenth of a degree of observed gravity, is designed to save over half the time of working out corrected gravity, and to eliminate errors. A.S.T.M. proportional interpolation replaces the Tag system of interpolation.

Proportional interpolation requires, for each run ticket, finding corrected gravity for the whole degree observed (disregarding the tenths), and also for the next higher whole degree of gravity, and the difference between them; multiplication of this difference by the tenths of the observed gravity; and addition of the product so obtained to the correction for the whole degree of observed gravity.

The Direct-Reading A.S.T.M.-I.P. Basis table gives corrected gravity, at a glance, for any tenth of any degree of observed gravity, from 14.0-69.9° A.P.I., and at any operating temperature.

Two companion books contain the 6-decimal factors to correct crude oil to its 60° F. volume, and simultaneously deduct any tenths of one per cent b.s. and w. up to full 2.0 per cent; either by multiplication, or by division; and for Gravity Groups I and II, or Groups I, II, and III; all on A.S.T.M.-I.P. basis. *The Oil Office Press.*

Check No. 11 On The Time Saver Card

●

Boost Pump Operates On Differential Area Theory

New high-pressure hydraulic boost pump, Model S-216-C, performs static testing on pipe and christmas trees, ejects core samples, pumps out sanded-up pump barrels, and will pump mercury. Eight standard models are offered for output fluid pressures to 30,000 psi. from 100 to 150 psi. plant-supplied air pressure. Boost pumps with capacities to 50,000 psi. are supplied on special order.

Sprague boost pumps operate automatically on the principle of differential areas. High hydraulic pressures are controlled by regulation of air inlet pressure. The boost pump is also available in a portable power unit, Model S-440, which includes air filter, air regulator, air gage, air lubricator, air shut-off valve, air muffler, pressure gage, and bleedoff valve; all mounted on a ½-in. base *Sprague Engineering & Sales Corp.*

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They're NEW

- Bulletins
- Catalogs
- Brochures

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Tubing Type Well Completion. A new, four-page, illustrated Technical Bulletin No. 303 describes an entirely new method of tubing type well completion using full size Glass Jet perforating charges. This new technique eliminates the need of running a special perforator with small jet charges through the inside of tubing, allows simultaneous multiple-zone perforation, and provides the full power of full-size jet perforating charges for deepest penetration. *McCullough Tool Co.*

Check No. 13 On The Time Saver Card

●

Arcon Structures. Design features, elevations, packaging, basic sizes, windows and doors, structural details, floor plans, and erection sequence of houses, office buildings, staff quarters, schools, and storage buildings are illustrated in a 50-page, multicolored brochure. The Tropical Roof, consisting of an upper and lower roof, designed specifically for tropical climates but also suitable under other conditions, is described in detail. *Taylor Woodrow, Ltd.*

Check No. 14 On The Time Saver Card

●

New Fittings and Piping Handbook. New 304-page fittings catalog and piping handbook gives detailed dimensional data and specifications on complete line of seamless welding pipe fittings, forged A.S.A. flanges, large diameter, and T.E.M.A. flanges, as well as screwed and socket welding fittings. Catalog includes 56-page technical data section featuring allowable stress and P/S tables, and maximum allowable working pressure charts. *Ladish Co.*

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●

Heat Transfer Equipment is a new eight-page bulletin on heat exchangers. Industrial heat transfer equipment is tailored to meet individual performance specifications in the heating or cooling of corrosive or noncorrosive liquids and gases. The bulletin illustrates different types and unit combinations of industrial heat exchangers. *Industrial Filter & Pump Manufacturing Co.*

Check No. 16 On The Time Saver Card

●

D-140 Le Roi. An eight-page illustrated brochure on an engine for operation on gas, natural gas, gasoline, or butane, is now available. Its advantages in use, its features, and specifications with laboratory power-rating chart are shown. *Southern Engine & Pump Co.*

Check No. 17 On The Time Saver Card

●

Cold-Aluminizing Prevents Corrosion and Prolongs Life. A new bulletin includes a reprinted case history of a 3-year service application test to which Kolmetal coatings were subjected. This new product, consisting of pulverized aluminum in a plastic base, is applied without heat to equipment and storage tanks. The bulletin covers characteristics and applications, and also includes a table of recommended uses and application instructions. *Emjay Maintenance Engineers.*

Check No. 18 On The Time Saver Card

●

Power Parade. The important part diesel power plays in the world's economy today is told in the spring issue of Power Parade, a booklet issued quarterly by *Detroit Diesel Engine Division, General Motors Corp.*

Check No. 19 On The Time Saver Card

●

Multiport Relief Valves for steam, air, and gas service are described in Bulletin 5200. The publication is replete with relief valve data. Charts, diagrams, tables, and a number of examples of plant operating conditions are presented as illustrations to show how to correctly select a Multiport relief valve. *Cochrane Corp.*

Check No. 20 On The Time Saver Card

●

Industrial Equipment. The new Bulletin WP-1099-B61 contains information about special features, types, sizes, and capacities of various product lines of industrial equipment, and describes the application of each of these lines in various industries. A number of illustrations show, as representative samples, how Worthington products apply in different types of industry. *Worthington Corp.*

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●

Non-Freezing Meter Bearings (Bulletin 52-R) and Sur-Way Unions (Bulletin 58-A). Both publications report recent adaptation of new materials to gain greater accuracy in metering and more constant operation without undue maintenance. They also note interchangeability with parts of other manufacture. *Industrial Instrument Corp.*

Check No. 22 On The Time Saver Card

●

Mayari-R, High-Strength Corrosion Resisting Steel. Catalog 353, containing 66 profusely illustrated pages, describes the properties and features of Mayari-R steel, its advantages in the manufacture and wear, and its corrosion-resistance properties in industrial equipment and equipment for the construction industry. *Bethlehem Steel Co.*

Check No. 23 On The Time Saver Card

●

Profitable Site Preparation is the title of a recently issued two-color, six-page booklet. The booklet, Form D423, illustrated with on-the-job pictures, deals with road building, clearing, leveling, water pit excavation, slush pit cleaning, and backfilling, all phases of site preparation which are the concern of the drilling contractor. *Caterpillar Tractor Co.*

Check No. 24 On The Time Saver Card

●

National Superior PTDS Supercharged Diesel Drilling Engines are described in Bulletin 415. Illustrations include cutaway views showing design features, dual fuel operation, and generator sets. Performance curves, dimensional diagrams, and specification tables on these 620 (continuous) b.hp. engines are included in this 16-page booklet. *The National Supply Co.*

Check No. 25 On The Time Saver Card

●

Flex Ring Closures for boilers, evaporators, heat exchangers, autoclaves, filters, fractionating towers, absorbers, pipeline scraper traps, and other pressure vessels and piping systems are thoroughly explained and illustrated in Bulletin 3,000. Data tables and price sheets are included. *Sillers Engineering Co.*

Check No. 26 On The Time Saver Card

●

Arceo Gravity Instruments for Specific Gravity of Liquids. Bulletin 111-R2 describes specific gravity instruments for use with liquids. Flow diagrams along with illustrations and engineering data on each instrument make this 12-page, 2-color book of value to men concerned with instrumentation. *American Recording Chart Co.*

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REFINING

ASPPA Asks Industry Bids On Last Half Fuel Supply

WASHINGTON.—The Armed Services Petroleum Purchasing Agency has asked the oil industry to submit bids on 11,800,000 bbl. of Navy special fuel oil and 8,800,000 bbl. of other products for delivery during the last 6 months of this year. Bids will be opened April 20.

In addition to the Navy special, ASPPA is preparing to buy 1,000,000 bbl. of No. 6 fuel oil, 3,450,000 bbl. of marine diesel oil, 1,175,000 bbl. of —70 pour point diesel fuel, 100,000 bbl. of 74/78 gasoline, 2,700,000 bbl. of 80/86 combat gasoline, and 390,000 bbl. of 80/88 gasoline.

ASPPA is now buying all products except high-octane gasoline on the basis of bids, it was disclosed by Col. Douglas R. Brown, director. It plans to go to the bid basis for purchase of high-octane fuel as soon as it is determined that sufficient quantities may be available in all areas.

American Liberty Puts New Thermofor Unit on Stream

MOUNT PLEASANT, Tex.—American Liberty Oil Co. has completed and placed on stream a new 5,100-bbl. Thermofor catalytic cracking unit at its refinery here.

Construction was started April 1, 1953, and completed in less than a year. Cost of the new unit was placed by a spokesman of the company in Dallas at about $4,000,000. Contractor was Fluor Corp.

Charge capacity of the Mount Pleasant refinery in Titus County, East Texas, currently is about 17,000 bbl. daily. American Liberty operates its own crude gathering system in the area, taking heavy 20° to 25°-gravity crude from Sulphur Bluff, Talco, Coke, Como, Alba, Yantis, Merigale, Manziel, Winnsboro, and Mitchell Creek fields.

Process Heating Seminar Scheduled for April 24

TULSA.—The fourth Process Heating Seminar, originally scheduled for April 17, will be held here April 24, with four papers scheduled for presentation, according to Robert Reed, chief engineer, John Zink Co., the meeting sponsor.

Papers to be presented and their authors are:

"The Application of Additives to the Burning of Residual Fuel Oils," E. C. Huge, Babcock & Wilcox.

"Refractories from Man-Made Minerals for Process Equipment," Arthur A. Turner and Roy W. Brown, Carborundum Co.

A paper on means for elimination of the problems of fouling and corrosion in process cooling equipment and on new angles on the problem of silica in boiler water, E. H. Hurst and W. A. Freiwald, National Aluminate Corp.

"Radio-Isotope Radiography and X-Ray Diffraction Analysis as Applied to Refinery

NELSON REFINERY CONSTRUCTION INDEX

Appears in the first issue each month.
Explanation—"News Items That Appear in Quarterly Cost Indexes," July 7, 1952, pages 105 and 106.
Compiled by W. L. Nelson—Petroleum Refinery Consultant—Tulsa.
Indexes of Individual Equipment Items—January, April, July, and October.

INDEX (1946 = 100)

	1948	1950	1951	1952	1953	Dec. 1953
Pumps, compressors, etc.	127.0	138.2	155.9	155.6	162.5	168.3
Electrical machinery	127.6	134.9	154.3	152.4	156.4	160.5
Internal combustion engines	116.9	126.0	146.1	146.5	148.1	149.7
Instruments	120.0	127.8	142.3	146.2	151.8	154.0
Heat exchangers	130.0	140.0	152.0	165.8	174.9	179.0
Miscellaneous equipment average	*122.1	*126.2	*145.1	153.3	158.8	162.3
Materials component	139.3	149.5	164.0	164.3	172.4	175.1
Labor component	128.0	144.0	152.5	163.1	174.2	179.3
Refinery construction index	132.5	146.2	157.2	163.6	173.5	177.6

*Used in computing the Nelson Index until April 1952. These are slightly different than the average of the miscellaneous equipment items shown above. †Corrected value.

Hottest New Idea from PERCO*

PEBBLES, like these, heated to very high temperatures, are used for cracking light hydrocarbons to produce ethylene.

The Pebble Heater is an apparatus for attaining temperatures beyond the range of conventional tube furnaces. Continuously circulating refractory balls (called pebbles) are heated by combustion gases by direct contact. The hot pebbles flow downward into a reaction chamber where they are contacted directly by the charge material.

Phillips Petroleum Company is currently operating a new 30 MM Btu/Hr Pebble Heater at ethane conversions of 90% and above.

The Pebble Heater is not limited to hydrocarbon processing but has wide application to superheating steam or air and the processing of corrosive materials.

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Problems," Arthur C. Sweeny, Jr., of Arthur C. Sweeny, Jr., Co.

Johnson Gets Contract For Mining L.P.G. Caverns

CLEVELAND. — Standard Oil Co. (Ohio) has awarded a $335,000 contract to R. G. Johnson Co., Washington, Pa., for the mining of two 30,000-bbl. underground storage caverns for storage of liquid propane and butane gases at its Lima, Ohio, refinery.

Johnson Co. is expected to start the mining job by April 1. A 455-ft. central shaft, 12 ft. by 12 ft., will be sunk and two caverns 120 ft. long, 50 ft. high, and 30 ft. wide, will be excavated in opposite directions from the shaft. Completion is slated for October. The project will permit greater recovery of propane in the Lima refinery.

Petrochemicals

Synthetic Ammonia Output Could Be Raised 16 Per Cent

NEW YORK.—Under an emergency domestic manufacturers of synthetic ammonia could boost their production by 16 per cent by removing bottlenecks and disregarding costs and inefficiencies.

At a recent meeting between Business and Defense Service Administration and industry representatives, present ammonia capacity in terms of nitrogen was reported to be 2,233,600 short tons annually.

New capacity now under construction will add 648,100 short tons by next year. To this projected basic capacity of 2,881,700 short tons, actual output could be stepped up to 3,164,100 short tons by operating plants without regard to cost and efficiency. Minor modifications and bottleneck removals in existing capacity could further boost production to 3,339,100 tons, said the B.D.S.A.

Adding an extra 265,000 tons, which can be supplied from byproduct and organic wastes, and 230,100 tons in certified projects not yet under construction brings the aggregate potential capacity to 3,834,200 short tons by 1957.

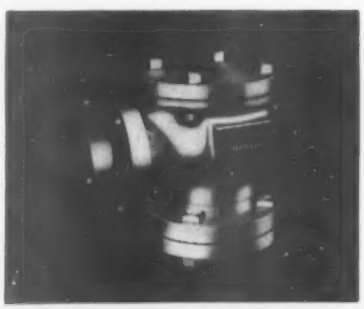
Glycols, Ethanolamines Get Tank-Car Price Cut

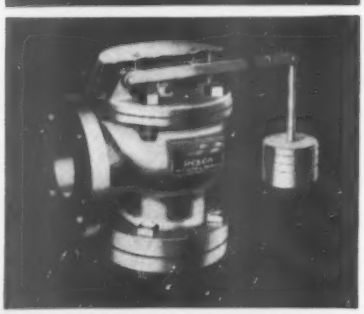
NEW YORK.—Prices for two major glycols and the group of ethanolamines have been reduced from 2 to 3 cents a pound in the face of increased production and reduced costs.

Ethylene glycol was reduced 3 cents a pound in tank-car price, from 14½ to 11½ cents. Di-ethylene glycol was reduced in tank-car price from 15½ to 13¼ cents a pound. Mono-ethanolamine was reduced from 26½ to 23½ cents a pound; di-esthanolamine from 26 to 23 cents and tri-ethanolamine from 23 to 21 cents a tank-car prices.

One of the cost reducing factors is a process employed by Nitrogen Division, Allied Chemical & Dye Corp., a new producer, at its Orange, Tex., plant. In the process, no chlorine is employed in the production of ethylene oxide and ethylene glycol.

OCECO vacuum and pressure RELIEF VENTS





● Ideally suited for a wide variety of vacuum and pressure relief requirements. Cast steel housings. Bronze or stainless steel trim. 3″ x 3″; 4″ x 4″; and 6″ x 6″ sizes. Standard A.S.A. flanges. Vacuum setting, 1½ oz. to 1 lbs. per square inch. Pressure relief valves provided with a lever and weight for settings from 2 lbs. to 30 lbs. per square inch as desired. Write for fully descriptive data sheet.

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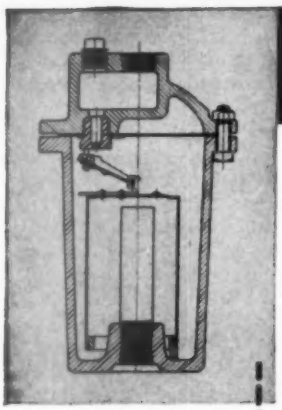

INVERTED BUCKET TRAPS with light weight buckets for draining light liquids from gases. The same design and operation proved on thousands of steam trap applications.

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. . . These ARMSTRONG TRAPS are the Maintenance-Saving Answer

ARMSTRONG traps extensively have been used to drain corrosive liquids from receivers and maintain the liquid level at any desired point. Bodies and caps have been furnished of nickel, aluminum-bronze, monel, stainless steel and other metals which can be cast or forged. Working parts, also, have been of nickel, monel, stainless steel or any weldable material available in sheet, rod and bar form.

Traps made of low carbon chrome iron, for example are being used to drain 60% Nitric acid from receivers at 75-100 psig. Perhaps you have a corrosive liquid control problem that can be solved with Armstrong traps. For complete data write:

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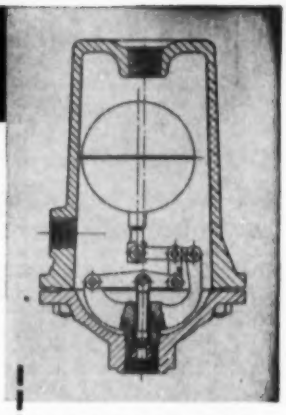

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NATURAL GAS

Pipeline Panel Set

S.G.A. meeting to feature seven transmission papers

HOUSTON.—A seven-paper information panel, entitled "Natural Gas Transmission," will be one of the highlights of the forty-sixth annual convention of the Southern Gas Association here, April 26-28.

Papers to be included in the papel are "Field Production of Natural Gas," W. T. Hollis, El Paso Natural Gas Co.; "Right of Way Problems," J. W. Polkinghorn, Texas Gas Transmission Corp.; "Compressor Station Operation and Maintenance," H. W. Egger, United Gas Pipe Line Co.; "Pipe Line Operations," W. B. Haas, Northern Natural Gas Co.; "Communications," M. O. Sharpe, Trunkline Gas Co.; "Natural Gas Processing," G. W. Gibbs, Natural Gas Pipeline Co. of America; and "Dispatching," T. K. Davis, Tennessee Gas Transmission Co.

H. F. Steen, El Paso Natural Gas Co., will be moderator of the information panel which will be held April 27 in a transmission session.

Two papers have been scheduled for delivery in a transmission session April 26, "Report on S.G.A. Pulsation Research Project," by Edward N. Henderson, Arkansas Louisiana Gas Co., chairman of the S.G.A. pulsation research council; and "Atomic Power for Industry," by R. B. Briggs, Oak Ridge National Laboratory.

Other sessions . . . In addition to the transmission sessions, other sessions will be held on accounting, employe relations, distribution, accident prevention, and sales. Also several general sessions and luncheon sessions have been scheduled.

One of the papers of interest to be presented in a session on industrial sales on April 26 will be "Free Piston Gas Turbines," by Robert P. Ramsey, Cooper-Bessemer Corp.

Two symposia have been scheduled for the distribution session on April 27, entitled "Effective Use of Short Wave Radio in Operating Distribution Properties" and "Service and Installation of Air Conditioning Equipment." In an April 26 distribution session, A. P. Rowland, Lone Star Gas Co., will deliver a paper, entitled "Restoration of Gas Service After a Major Interruption," which relates to tornado damage at Waco, Tex.

General session and luncheon speakers will include E. H. Eacker, president of the American Gas Association; Dr. Watrous H. Irons, vice president of the Federal Reserve Bank of Dallas; J. E. Hodges, economist for Hughes Tool Co. and head of the department of economics at Rice Institute; and Gordon C. Griswold, assistant vice president of Brooklyn Union Gas Co.

Storage Expanded

10-year capacity growth reported at 1,190 per cent

NEW YORK. — Underground gas-storage capacity has been expanded from an estimated 135,000,000 M.c.f. in 1944 to approximately 1,770,000,000 M.c.f. last year, an increase of 1,190 per cent in the past decade.

These figures were presented in a report for 1953 by the American Gas Association underground-storage committee.

During 1953 ultimate capacity of existing storage pools was increased by 35 per cent, from 1,290,000,000 M.c.f. in 1952 to 1,740,000,000 M.c.f. in 1953. Pools currently being developed will add another 315,000,000 M.c.f. of capacity.

The report showed there were 167 underground natural-gas storage pools operating in 17 states by the end of 1953, compared with 50 pools operating in 11 states during 1944.

For the year ended October 31, 1953, input to underground storage was 403,000,000 M.c.f. of natural gas, compared with production from storage of 233,000,000 M.c.f. for the same period.

Three gas categories . . . Ultimate capacity of existing natural-gas storage pools last year comprised three main categories—working gas, cushion gas, and native gas.

Most of the capacity, 982,000,000 M.c.f., was working gas, which is available for immediate use.

There was 496,000,000 M.c.f. of cushion gas, which furnishes the producing pressure for removal of gas from storage.

There was 260,000,000 M.c.f. of native gas which had been left in original gas wells after they had ceased being commercially productive and were used for storage.

The survey showed that 37 companies had underground storage operations in 1953, compared with 35 in 1952. The number of active wells, from which stored natural gas was withdrawn, was increased from 4,940 to 5,789 during 1953.

Of the storage pools in operation during 1953, 55 were in Pennsylvania; 28 in West Virginia; 14 each in New York and Kansas; 12 in Michigan; 11 in Ohio; and 33 other pools in 11 other states. Of these 167 pools in 17 states, 155 originally were dry gas reservoirs; 8 combined oil and gas; 1 oil; and 3 water.

1953 Natural-Gas Revenues Up 14.8 Per Cent Over 1952

NEW YORK.—Natural-gas revenues for 1953 were $2,250,000,000, or 14.8 per cent above revenues of $1,961,000,000 in the previous 12-month period, according to the American Gas Association.

The association reported that natural-gas sales for the 12 months ended December 31, 1953, totaled 53,456,000,000 therms, a gain of 8.4 per cent over sales of 47,293,000,000 therms in the previous 12 months.

Total operating revenues of the gas utility and pipeline industry during 1953 reached a record high of $4,020,000,000 a gain of $450,000,000 or 12.6 per cent over the figure for 1952. Net operating revenues increased from $470,000,000 to $495,000,000 in the same period, a gain of 5.3 per cent.

Total operating expenses represented 87.7 per cent of total operating revenues as compared with 86.8 per cent in 1952. Total operating expenses per therm of sales for the gas industry increased from 5.89 cents per therm in 1952 to 6.22 cents per therm in 1953, primarily reflecting the continued advances in field prices of natural gas.

A therm is 100,000 B.t.u., roughly equivalent to the energy produced by 100 cu. ft. of natural gas.

Texas' January Gas Output Reaches Record High Level

AUSTIN.—Natural-gas production in Texas reached a record high level during January, when the Texas Railroad Commission reported production at 482,109,865 M.c.f., an increase of 1.91 per cent over January 1953.

Of total gas production reported to the commission, 382,261,992 M.c.f. was marketed—332,982,348 M.c.f. to transmission lines. A total of 10,266 gas wells produced 362,458,415 M.c.f. of the gas in January and 119,651,450 M.c.f. was casing-head gas produced from 92,030 oil wells.

THE 1954 FLUOR FIN-FAN

offers improved engineering features for:

FLUOR LOUVER SHUTTERS mounted above the fin-tube sections offer protection during cold weather and regulate the flow of air across tubes to maintain constant exit fluid temperatures in frigid climates.

COLD WEATHER PROTECTION

For protection during severe cold and to prevent exit fluid temperatures from dropping below the design point, Fluor Fin-Fan air-cooled heat exchangers may be equipped with louver-type shutters over the fin-tube sections, or with rolling steel doors at ground level to regulate the flow of air across the extended surface. In extreme cases air can be recirculated to maintain desired temperatures. Fluor furnishes Fin-Fan installations for reliable performance under any weather conditions.

AUTOMATIC TEMPERATURE CONTROL

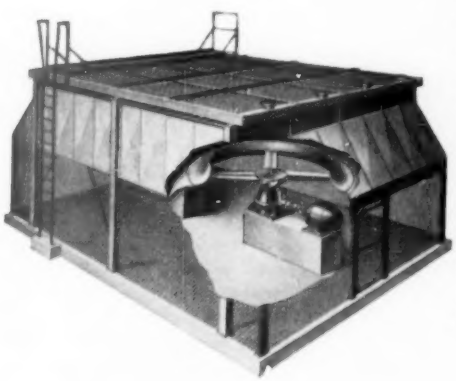
In addition to the above, Fluor makes available automatic temperature control equipment which, by means of varying fan speed, assures constant exit fluid temperatures. Savings in operational horsepower are also effected. The type of equipment available consists of variable speed fluid drives (hydraulic couplings) and variable speed hydraulic drives.

IMPROVED HEAT TRANSFER

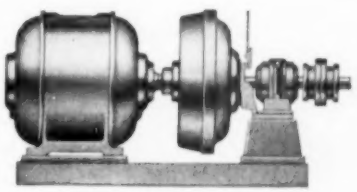
Fins are applied to the tube so that each individual fin overlaps at its base and seals against the adjacent fin, completely encasing the entire length of the tube, thus resulting in improved heat transfer efficiency. Protected from exposure, tubes do not require a coating to prevent them from corroding. Fins remain rigidly in place with no opportunity to work loose. Tubes are furnished in Admiralty, carbon steel, aluminum or any other commercially available material.

PROTECTION TO EQUIPMENT

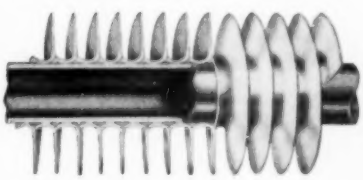
The Vibration Cut-Out Switch, which immediately cuts off power should excessive vibration occur, was developed and patented by Fluor. These switches have long been standard equipment on Fluor induced-draft cooling towers and Fin-Fans, and proved their worth by cutting off the power at recycle and gasoline plants during the earthquakes in and around Bakersfield in the summer of 1952. They also serve as a position on-off switch during routine inspections. Manual reset prevents motor from being started accidentally when the switch is in "off" position.



ROLLING STEEL DOORS may be used in place of shutters for controlling amount of cooling air through fan and for protection during severe cold weather.



VARIABLE SPEED FLUID DRIVE regulates fan speed automatically, controls temperatures, saves power, increases operational life of mechanical equipment.



FIN stock completely encases the tube from one end to the other to provide high heat transfer efficiency while protecting tubes from corrosion.

VIBRATION CUT-OUT SWITCH immediately cuts off power and stops fan, should excessive vibration occur, thus preventing possible damage to Fin-Fan.

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PIPELINE

Plans Approved

Six Columbia Gas firms to build new facilities

WASHINGTON.—Six subsidiaries of Columbia Gas System, Inc., have received Federal Power Commission authorization for construction of new pipeline facilities, estimated to cost more than $40,000,000, and designed to generally increase the system's capacity.

The construction projects were approved for Manufacturers Light & Heat Co., Central Kentucky Natural Gas Co., Home Gas Co., Atlantic Seaboard Corp., United Fuel Gas Co., and Ohio Fuel Gas Co. The construction is part of the $110,000,000 expansion program planned by Columbia Gas this year *(The Oil and Gas Journal, March 29, page 150).*

The projects approved by the FPC for the subsidiaries are as follows:

Atlantic Seaboard—estimated to cost $14,619,300 and includes about 116 miles of line paralleling sections of existing line between Cobb, W. Va., and Rockville, Md., including about 10½ miles of looping line near Baltimore, Md., and 4,400 hp. in new and existing compressor facilities.

United Fuel and Central Kentucky—estimated to cost $9,114,222 and includes about 59 miles of line and a 6,000-hp. compressor station.

United Fuel—estimated to cost $2,240,000 and includes construction of a 4,400-hp. compressor station in Jackson County, West Virginia.

Manufacturers—estimated to cost $3,747,446 for activation of a new underground storage field in Wetzel and Marshall counties, West Virginia, and to connect the new pool with existing facilities; includes about 33.7 miles of main transmission line, 21½ miles of main storage field lines, 17.1 miles of field well lines, and a 1,760-hp. compressor station.

Manufacturers—estimated to cost $5,968,300 for eight separate jobs, including replacement of existing facilities around Pittsburgh, Pa., and the northwest panhandle of West Virginia, reinforcement of the system in and around eastern Pennsylvania near the Maryland State line. The project includes about 75 miles of line and 4,400 hp. of compressor capacity.

Ohio Fuel Gas—estimated to cost $2,668,000 and includes about 63 miles of line, largely to replace existing facilities and provide additional capacity.

Home Gas—estimated to cost $2,160,500 and includes about 50 miles of line in sections from Maine to Tioga, N. Y., and Deposit to Port Dickinson, N. Y., completing replacement of the company's multiple 6-in. system from Quackenbush Hill to Port Jervis, N. Y.

New Records Set

Traffic, revenues reach new peaks for oil lines

WASHINGTON. — New peaks in traffic and transportation revenue were reached last year by the major oil pipeline companies reporting to the Interstate Commerce Commission.

The 57 companies from which the ICC receives statistics handled 3,554,048,844 bbl. of oil and products and had a transportation revenue of $548,010,481 in 1953, compared with a movement of 3,294,416,788 bbl. and a revenue of $521,713,275 in 1952.

This high level of activity was attained despite the fact that 20 companies handled less traffic than in 1952 and 23 reported declines in transportation revenue.

Analysis of the returns by the ICC disclosed that 11 companies handled in excess of 100,000,000 bbl. of oil and between them accounted for more than 1,950,000,000 bbl. of the total movement.

Volume rankings . . . The top companies were Humble Pipe Line Co. with 272,253,401 bbl. against 295,079,463 bbl. in 1952; Gulf Refining Co., 249,950,613 bbl. against 198,369,586 bbl.; Texas Pipe Line Co., 207,768,186 bbl. against 209,987,095 bbl.; Interstate Oil Pipe Line Co., 185,349,973 bbl. against 185,233,421 bbl.; Service Pipe Line Co., 182,664,234 bbl. against 182,087,866 bbl.; Buckeye Pipe Line Co., 179,369,532 bbl. against 197,345,943 bbl.; Sinclair Pipe Line Co., 176,174,818 bbl. against 169,967,557 bbl.; Magnolia Pipe Line Co., 175,576,366 bbl. against 163,653,183 bbl.; Ohio Oil Co., 167,325,081 bbl. against 150,779,109 bbl.; Shell Pipe Line Corp., 144,453,307 bbl. against 142,350,947 bbl.; and Phillips Pipe Line Co., 110,732,109 bbl. against 104,513,234 bbl.

There were also 11 companies with transportation revenues in excess of $20,000,000 accounting for approxi-

mately $357,000,000 of the total for the 57 companies.

They were Service Pipe Line Co. (fifth in volume), $56,320,643 against $57,556,044 in 1952; Sinclair Pipe Line Co. (seventh), $38,722,980 against $37,140,595; Humble Pipe Line Co. (first), $38,094,641 against $41,976,790; Great Lakes Pipe Line Co., $35,713,026 against $34,332,240; Magnolia Pipe Line Co. (eighth), $33,390,339 against $31,262,474; Texas Pipe Line Co. (third), $31,915,026 against $33,797,133; Shell Pipe Line Corp. (tenth), $29,005,884 against $30,213,621; Gulf Refining Co. (second), $28,946,089 against $30,747,635; Phillips Pipe Line Co. (eleventh), $23,915,477 against $19,842,399; Plantation Pipe Line Co., $21,458,321 against $18,788,416, and Interstate Oil Pipe Line Co. (fourth), $21,406,568 against $21,253,666.

Lines Planned

Great Lakes to increase products-system capacity

KANSAS CITY, Mo.—Great Lakes Pipe Line Co. has announced new products pipeline construction for this summer which will provide increased capacity for the company's delivery terminals at Alexandria, Minn., and Fargo and Grand Forks, N. D.

A 12-in. line will be laid laterally from existing lines near Minneapolis westward to Willmar, Minn. (an estimated 100 miles), where it will parallel the present 8-in. line to Alexandria (an estimated 62 miles). From there an 8-in. extension will be built along the route of an older 6-in. line to Fargo (an estimated 104 miles).

Great Lakes officials said the new lines will be completed in August and will supply adequate capacity for movement of burning oils in advance of the heating season.

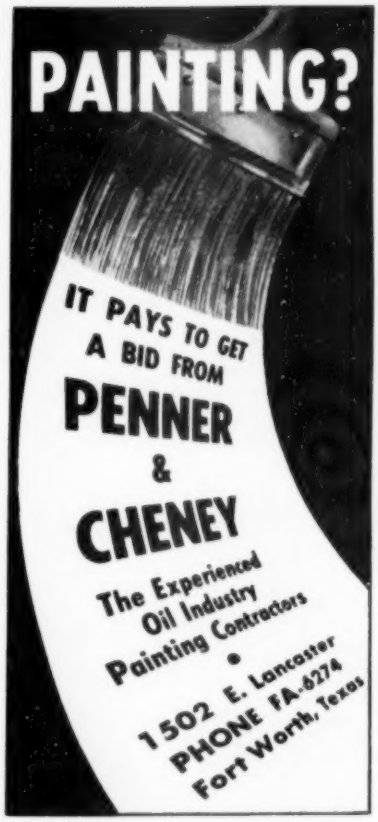
The company also announced that a 12-in. line will be laid this summer between Kansas City, Mo., and Des Moines, Iowa, (about 188 miles) to supplement its 12-in. and two 8-in. lines between those points.

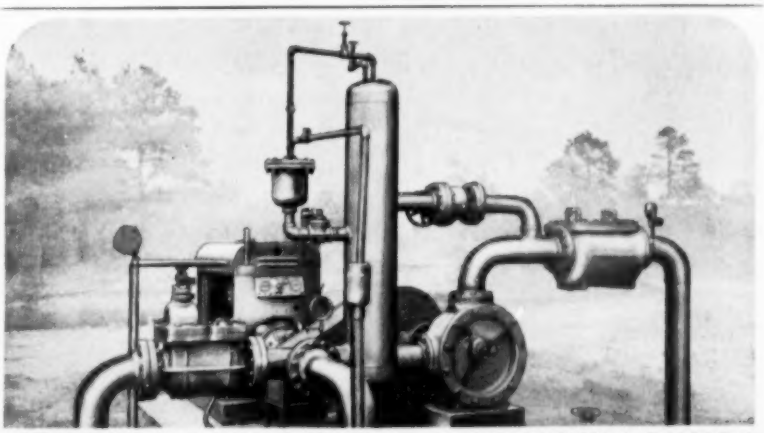
Pump station additions . . . Also, capacity of the company's existing 12-in. line between Des Moines and Minneapolis will be increased by installing pumping stations at existing mid-point stations to give 50-mile pump station intervals instead of the present 100-mile spacing.

Previously announced was an estimated 150-mile 8-in. line between Iowa City, Iowa, and a point near Prophetstown, Ill., where it will connect with Badger Pipe Line Co.'s line from East Chicago, Ind., to Madison, Wis.

Another previously announced project is a 130-mile 8-in. extension from Nebraska City to Grand Island, Neb.

Great Lakes also announced that regular grade gasoline tendered to it must have a minimum octane number of 84.5 by the research test method, up one octane number, effective March 25. The octane requirement of premium grade gasoline tendered to the system was increased one octane number, from 91 to a minimum of 92 octane, effective March 15.





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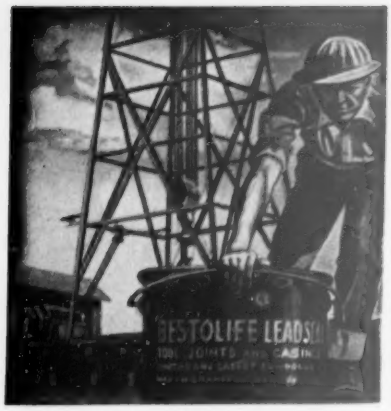

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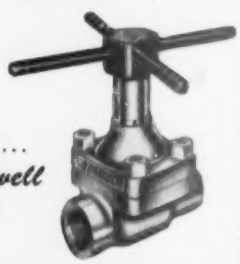

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Among the Drilling Contractors

Rigs Ordered to Launch New Australia Drilling

Plans are taking shape for additional drilling to get under way shortly in Australia. Since the continent's recent initial oil discovery by Australian Petroleum Pty., Ltd., on the Rough Range near Exmouth Gulf, 600 miles north of Perth, in Western Australia, that company has purchased an Ideal 100 rotary rig from the Australian Federal Government, and has placed orders for two Ideal 32 rigs.

One of these rigs will be used in further development of the relative shallow producing horizon found by the discovery well, now drilling ahead in exploration of prospective deeper productive formations. Another will be used on the initial test on the company's nearby Cape Range structure. The third will drill the company's first test in the Fitzroy River area, Desert basin, 700 miles north of Exmouth Gulf.

The rig on the Rough Range discovery well is a deep-drilling assembly owned and operated under contract by Brown Drilling Co., Long Beach, Calif.

In the meantime, R. A. Powell and Leo Goss, directors of Santa Fe Drilling Co., Santa Fe Springs, Calif., are in Australia in connection with possible exploratory drilling for Australasian Oil Exploration on Reid's Dome in Queensland, northeastern Australia, and on territory held by Universal Consolidated Insulating Co. in Western Australia.

Oil Corp. has a rig running for H. R. Smith at a wildcat location 3½ miles west of Mineral, in Bee County, South Texas. The new operation, 2 DuBois, is about a mile south of the operator's first well on the lease which was quit recently as dry at 6,811 ft. It is about a mile east of Goree field, productive of gas and condensate from the Slick sand at 7,065 ft.

Fortenberry Drilling Co., Natchez, Miss., is keeping a rig busy in Sunnyside field, Jefferson County, Mississippi, where it is drilling for J. Willis Hughes. The rig has just completed 1 Tyler-Green unit, a dry hole in the Wilcox

Harrell Drilling Co., Houston, has a rig working for Christensen & Matthews, also of Houston, in the Bender-Kuhlman area of northern Harris County and southern Montgomery County, Texas Gulf Coast. Shown on the rig floor are (left to right, standing): Chuck Bates, tool pusher; H. M. Harrell, owner of the contracting company; Bill Christensen, partner in the operating firm; "Doc" Burnett, driller; and L. D. Wristen and J. A. Appling, crewmen; and (front row, same order) J. B. Marsh and B. J. Hasting, crewmen. (Photo by courtesy Mission Manufacturing Co., Houston.)

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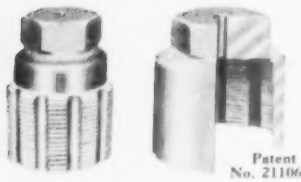

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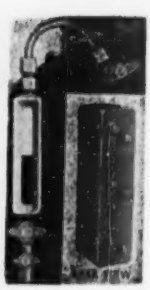

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formation, and is starting 4 Hall. Drilling depths in the area are around 6,300 ft.

Roberts & Lee, Bakersfield, Calif., will drill for Richfield Oil Corp. at a wildcat location midway between Wheeler Ridge and Los Lobos fields, in Kern County, California. Location is for 3 San Emidio, in 32-11-21. Hole will be carried below 6,000 ft.

Gene Reid Drilling, Inc., Bakersfield, Calif., is drilling another test for Harry H. Magee in the Firebaugh area, 50 miles northwest of Fresno, in Fresno County, California. Operation is 3 Howard, in 35-11-14. This contractor also is drilling on another new contract, a 7,000-ft. Eocene test for Capital Co. on the west edge of Kern Front field, north of Bakersfield, in Kern County.

Jet Drilling Co., Denver, has a new wildcat under way for Braden-Hoover & Kejr in the northeastern corner of Weld County, Colorado. It is designated as 1 Peavy. Location is in 1-11n-56w.

Roden & McRae Drilling Corp., Denver, is under contract to Shannan Oil Co. for a deep test to be drilled northwest of Murphy Dome, in southern Washakie County, Wyoming. Location of the test, 1 Government, in 31-44n-91w, is just north of the Hot Springs County line.

Delta Gulf Drilling Co., Tyler, Tex., has two new contract jobs under way in Acadia Parish, Coastal Louisiana. One is a projected 11,850-ft. test, 1 Wright, for Sun Oil Co. in the Midland area. The other is for Stanolind Oil & Gas Co. at 1-B Savoy, in the Bayou Mallet area.

ACTIVE ROTARY RIGS*

Area—	Week ended 3-29-54	Change week ended 3-22-54	3-30-53
Gulf Coast	531	— 1	—54
N. & W. Tex.-N. M.	771	— 35	— 61
Ark.-N. La.-E. Tex.	177	— 21	+56
Oklahoma	383	— 12	+62
Kansas-S. Nebraska	148	— 15	—32
Illinois-Eastern	132	— 1	+43
Rocky Mountains	225	— 5	+37
Pacific Coast	140	— 8	—24
Total U. S.	2,507	— 98	+27
Western Canada	147	— 2	—12
Total	2,654	—100	+15

*Courtesy Hughes Tool Co. Trends in drilling activity in the United States, and the North and West Texas-New Mexico, and Oklahoma-Kansas areas are shown on pages 185 and 186.

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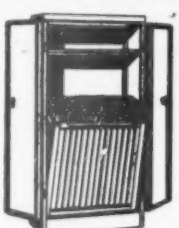

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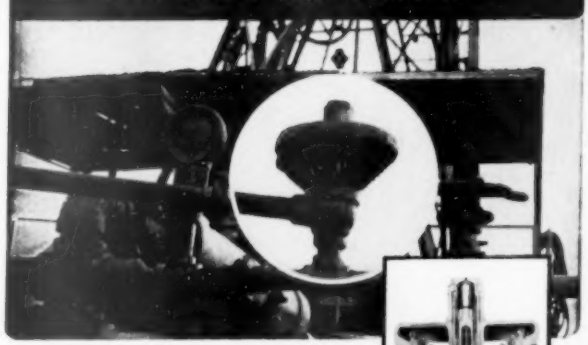

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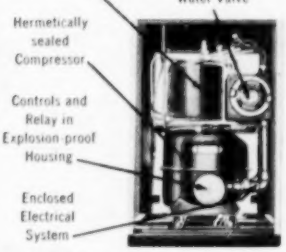

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EXPLORATION

Raton . . . Frontier Exploration in Action

by Frank J. Gardner

HERE is a basin. It holds 20,000 ft. of sediments. It holds promise of oil, but has never produced a drop. It is the Raton basin.

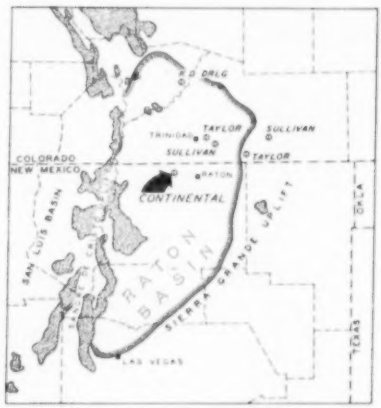
Geologists like basins. They like this one, but they don't know much about it. They don't know much about it because it's a frontier. This is frontier year in the geology business.

Frontiers call for pioneers, and Continental Oil Co. is a pioneer. It likes this basin, too—it likes it to the extent of about 500,000 acres of leases on the New Mexico side and 170,000 acres on the Colorado side. It likes it in such measure that two wildcats have been located on the New Mexico side, and two more are committed for the Colorado side.

It's a small basin, as basins go—only about 65 miles wide and 160 miles long, with an area of about 10,000 sq. miles. Its actual boundaries are not known, but compared to Williston or Denver-Julesburg, it's small. It lies between the Sangre de Cristo Mountains on the west and the Sierra Grande Uplift on the east. To the northeast, it is separated from Denver-Julesburg basin by a small uplift called Apishapa; its southwestern limits are not certain, but the Pedernal highland forms a definite barrier there. It is part of a great geosyncline trending northwest-southeast from North Central Colorado into northeastern New Mexico.

Very few wells have been drilled in the Raton basin . . . only 50 or 60. Most of these were too shallow to be revealing, and most of them left only drillers' logs as records, because, strangely enough, they were drilled before electrical logging was in use. No tests at all have been of consequence in the deep center of the basin, and this is why the industry will watch the operations of Continental with close concern.

Here we are witnessing an exploration phenomenon—this is the way the United States oil industry keeps its oil reserves abreast and ahead of consumption. Continental may fail in its efforts to open this basin to production, but if it does, the next pioneer in line will have subsurface cores to guide him.



The Raton basin of northeastern New Mexico and southeastern Colorado will be explored in a series of deep tests by Continental Oil Co.

That's something more than Continental has; it has geophysical pictures and core-drill data, a picture of environment, and lots of surface dope.

What's in this basin to tempt the drill? Where does its promise lie? The answer is manifold.

First, a sequence of Paleozoic and Mesozoic strata, generously marine and attaining a thickness of some 20,000 ft. Of these strata, perhaps the greatest potential oil rocks will be the 8,000 ft. of Pennsylvanian sediments, especially the Magdalena limestone. An equal thickness of Permian beds offers little hope, but above them, Cretaceous sand bodies provide the second best chance of production, especially the Dakota sandstone. Cretaceous sediments range from 1,500 to 3,500 ft. in thickness, and over them are Tertiary beds up to 1,000 ft. thick.

Second, the probability of numerous subsurface folds flanking the foothills of the Sangre de Cristo range provides a lure. Some geologists fear, however, that the terrific hydrostatic heads engendered by fluids entering formation exposures on the basin flanks may have flushed these structures clean of oil. This didn't happen in Denver-Julesburg. Why here?

Third and greatest inducement to drill here is the expectation of stratigraphic traps, both in the center of the basin as a result of swift facies changes, and on the eastern flank as a result of overlap on the Sierra Grande Uplift. On this eastern flank, the Permian beds lie directly on the granite basement; somewhere, the overlap has sealed the Pennsylvanian edge, and in that somewhere lies perhaps the greatest promise of production. Between the western edge of the basin and its eastern flank, some 14,000 to 15,000 ft. of section is lost to this overlap.

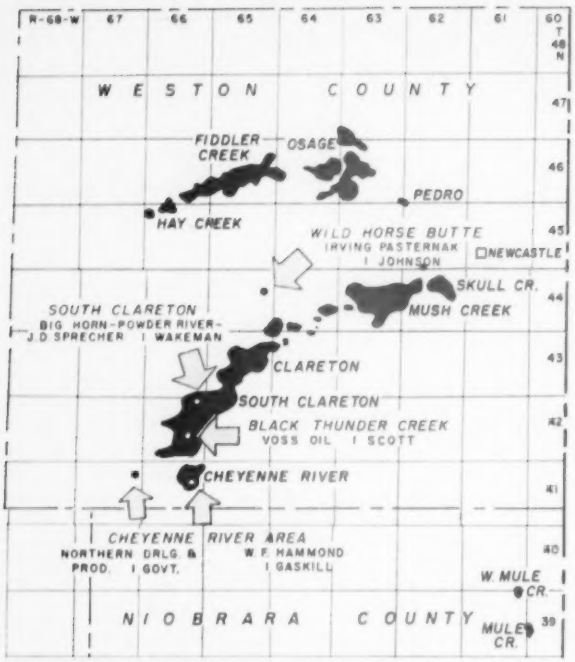
On the map, more than one pioneer is shown at work; J. Taylor, of Amarillo, has had an active drilling schedule under way in Las Animas County, Colorado, for the past few months, and two of his rigs are active now. Bruce Sullivan is probing the same basin flank with two tests, and Lewis Drilling Co. and K. D. Drilling Co. have tests under way on the north flank of the basin in Huerfano County.

But Continental has taken a plunge into the center, and these will be crucial tests. The 1 and 2 St. Louis, Rocky Mountain & Pacific Co. have been staked as definite locations west and south of Raton townsite. One will go to 7,000 ft. for a test of the Pennsylvanian; the other to 5,000 ft. to probe the Dakota. Both will be significant, and both will provide an exploration precedent.

To the north, beginning at the Colorado State line, Continental has arranged for exploration of the Maxwell Land Grant of southern Colorado. Under agreement with Colorado Fuel & Iron Co., the company now holds a 2-year exploratory option on 170,000 acres. Two wells are agreed upon, one to begin by October 1, 1954, to test the Fountain (Pennsylvanian) beds, to a minimum depth of 6,500 ft.

Things equal to the same thing are equal to each other; that's an old mathematical fact. Proceeding from theorem to theory, why should not the same essential conditions that account for oil pools in the Denver-Julesburg basin be found at Raton?

Here is frontier exploration in action. Here are speculation, vision, imagination. This is frontier year in the geology business.



Activity map of Weston County, Wyoming, where 36 per cent of the hole drilled in the entire state was concentrated in 1953.

Preparing for completion of an average well in the South Clareton area of Weston County, Wyoming.

WESTON COUNTY, WYOMING

Rockies' Most Concentrated Drilling Program

Only 42 of 260 wells completed in 1953 failed to find production

THE biggest concentrated drilling program in the Rocky Mountain region during 1953 was conducted in Weston County, Wyoming, south and west of previous production in Clareton field.

Nearly 36 per cent of the hole made in Wyoming during the year, the best on record for the state, was made in Weston County. The 260 completions there made up more than 28 per cent of the Wyoming total.

Activity in the county, on the east side of the Powder River basin, had been steady, but at a relatively low level since the end of the Fiddler Creek-Mush Creek-Clareton development which began shortly after the end of World War II. In January of last year J. D. Sprecher, of Casper, and Big Horn-Powder River Corp. tested 1 Wakeman, NE NW NE 1-42n-66w, 2 miles southwest of previous production at Clareton for a flow of 975 bbl. of oil daily through 24/64-in. choke.

Renewed activity following discovery . . . Following this discovery a substantial program of additional exploration and development began. It built up rather slowly, but by midsummer more than 50 rigs were working in the area southwest of the older Clareton field.

By autumn, operators were reporting at least one successful completion a day, and Newcastle, again the center of operations for a highly active area, was hard pressed to accommodate the influx of operators and field personnel. Someone said, at the height of 1953 activity, "It's the only town in the state where you can't find a place to stay while you look for a place to live." The net result was that 260 wells were completed in Weston County by the end of the year. Of these, 20 were exploratory, with 5 successes. Only 27 of the 237 development wells drilled failed to find production.

More than 1½ million feet of Wyoming's total of nearly 4.6 million feet of drilling in 1953 was done in Weston County alone.

As 1954 began, activity in the county had slackened but a little. Part of the slowdown observed was due to seasonal weather, part to difficulty in getting production to market.

Meanwhile, production was extended more than 20 miles south of the original Clareton field. The trend is 7 miles wide in some places, with an average of more than 4 miles.

Production was found in Niobrara County early in 1954, and in March the southern limit of the so-called trend had not been found. Definition of the field was not established east to west either, with only a few dry holes showing along the producing area.

Producing horizon . . . Production in Weston County, both in the older fields and in the area of present development, is from the Newcastle sandstone (Cretaceous) which is analogous to the Muddy in other parts of the state. Pay sections are more than 16 ft. in thickness in many parts of the South Clareton area.

Operators in the area report as many as five producing zones within the Newcastle in some wells. Others, nota-

bly those active in the Cheyenne River area at the southern boundary of the county, report only one producing zone.

Drilling depths range from 6,300 ft. in the northern part of the South Clareton trend to 7,300 ft. farther south. Exceptions to these limits may be found, particularly to the southwest of present established areas where depths are greater, but the average completion depth is within this range.

Drilling practices . . . The average time from out from under surface to bottom is about 15 days. Wells in the 5,800-6,800-ft. class take a little less, with 11-12 days not uncommon, while wells 6,800-7,200 ft. may run over the 15-day figure. Drilling in the area, then, is not regarded as particularly fast and easy, certainly not by comparison with the very rapid work of the Denver-Julesburg basin in Colorado and Nebraska, but is somewhat faster than much other Wyoming work.

Fifteen to 16 rock bits are used on the average Weston County well. This figure, too, is subject to some variation. A case in point is a 6,350-ft. well recently drilled which used 18 bits.

Lost-circulation problems . . . The principal difficulty in drilling in the county is with occasional lost circulation. Where encountered, loss of circulation usually shows up in the Wall Creek (Upper Cretaceous) sands. Cost of a completion is sometimes subject to fluctuation depending on circulation. While an average mud cost of $500 per well is quoted by many operators, one contractor recently completed a producer at below 6,000 ft. for the fantastically low mud and chemicals bill of $68.00. This "cheapy" in the mud department followed a completion which lost a little circulation to the tune of $3,800 total cost for mud and chemicals.

Water for drilling is not the most plentiful commodity on the east side of the Powder River basin. Fortunately, water wells sufficient for drilling can be brought in generally at from 160-300 ft. The ground-water supply is undependable enough, however, that a number of truckers have set up thriving enterprises hauling water from the Cheyenne River which crosses the trend east to west about 15 miles below the pre-1953 limits of Clareton production. Ranchers get 2 cents per barrel from the trucker who fills up for delivery at 20 cents per barrel at well site.

Practically all completions are with cable tools. Rotary tools drill through Newcastle sand and move off after casing is landed.

General view of downtown Newcastle. The town is headquarters for the Weston-Niobrara counties operation. Schools, housing, telephone, and business-location facilities have all been overtaxed during the past year as operators and supply and service firms moved into the area.

Sandfrac stimulates development . . . The efficiency of the Sandfrac process for Weston County reservoir rocks is perhaps the biggest single factor in the present large-scale drilling program. While flow gages of 1,500 bbl. per day and above are relatively common, after fracturing, the large majority of wells in the area come nowhere close to this gage natural.

Development of Mush Creek, north of Clareton, in the early postwar years was on a largely uncontrolled basis. The formation was shot with nitroglycerin as a nearly routine method of completion. Initial potentials in this earlier field were large, and production curves later declined rapidly. Ready market was available during the development of these older fields.

This early and sharp decline in production in older Weston County fields was responsible for the caution with which operators approached the 1953-54 development in its early stages. It was not until the Sandfrac process had proved itself particularly adaptable to the area that operators moved in in numbers for large-scale work.

No long-term assessment of the production expectancy of wells in the trend has been possible. Since the development began, production has been limited by pipeline capacity. Limitation was at first 100 bbl. per day per well, then 75 bbl., now 50 bbl. The present take is in spite of increased pipeline capacity from the area, and of course reflects the large number of producers completed.

At the present time Sandfrac is the universal treatment at completion, although acid is sometimes used in conjunction with this treatment.

Through the South Clareton trend generally, maximum pressure during fracturing is about 2,800 psi. Along the southern portion of the producing area the sand is tighter, with pressures up to 3,200 psi. not uncommon. To the north on the east side of the trend, breakdown often takes place at about 1,900 psi.

Lease situation tight . . . The county has been heavily leased. Acreage through the active areas within any reasonable projection of the trend commands very topheavy deals. Following the early development in Weston County, federal acreage in northern Niobrara County and in northwestern Converse County was rapidly leased. Lease ownership is highly diversified, one factor which has supported the high level of activity.

The entire east side of the Powder River basin has always been an area where exploration and development are dominated by independent operators. There are a few major companies in evidence through Weston and Niobrara counties today, but the number of independents is large.

Perhaps there is no other relatively small area with as many individual participants, both as operators and as interest holders. During the past 12 months a continuing effort by most of the independents in the region to acquire Weston County interests has materially assisted in the rapid development of the area.

Principal operators . . . Some of the operators prominent in the present development were heavily interested in the development of the Mush Creek-Fiddler Creek fields a few years ago. Among these are L. M. York and Voss Oil Co., to name only two. In addition to Sprecher and Big Horn-Powder River Corp., drillers of the South Clareton discovery, R. L. Manning, Jr., True & Brown, Dunbar Drilling, Irving Pas-

ternak, James P. Sloss are among the very large group now active in the area. A complete list of participants in the area's current development would be a major task to assemble.

Major companies active in the area include Continental Oil Co., and The Texas Co.

Market . . . The principal problem of the current development of the area has been and still is the question of movement of crude. The Plains Pipe Line to junctions at Lance Creek is the only pipeline outlet. As already mentioned, its take limited production from the beginning of operations in South Clareton. It has recently been purchased by Murchison interests, with the Voss Oil properties also going to the same buyer, who has invested heavily in the area.

Some expansion in the Plains system has been effected, but it was not enough to materially affect per well take. While activity has been high since the first of the year, a recent report showed 21 rigs active in Weston and Niobrara counties, with 38 stacked. The idle rigs were generally attributed to the market situation.

Some oil has moved from the area under distressed conditions. The first serious discussions of possible proration for Wyoming were brought about late in 1953 by this situation. The Northeastern Wyoming Oil Producers Association has been organized to attempt a solution to market problems.

A considerable amount of gas is produced with Weston County oil. The average gas-oil ratio is about 900-1. Flaring of gas from the field is a serious problem which is now nearing solution by construction of a natural-gasoline plant in the area by Wyoming Gas Products Co. (also a Murchison firm). Completion is expected this year.

Future operations . . . During 1954, Weston County completions have continued at a high rate. The expansion into Niobrara County to the south has opened a great deal more semiproved territory. The level of operation during the coming summer is almost sure to be at least as high as in 1953. The highly diversified lease situation will tend to keep activity high, despite market troubles.

With Rocky Mountain region completions running at an all-time record rate in 1954 (even by comparison with 1953) total completions for the region seem sure to exceed 4,500. Of this total, the Weston - Niobrara counties area may be expected to produce upwards of 500.

Calculation of reserves, and an accurate report on production under present well diversified operations are very difficult. Even without reliable figures in this respect, it is safe to conclude that the east side of the Powder River basin is to be one of the most important and influential areas south of the Williston basin so far as Rocky Mountain operations for the next 2 or 3 years are concerned.

KANSAS

Lansing Oil Shows to Be Tested at Barton Well

E. K. Carey Drilling Co. will test Lansing oil shows at 1 Munns, C N½ NW SE 23-17s-13w, 1½ miles east of Hoisington pool in Barton County on the central Kansas uplift.

Recovery on a drill-stem test in the Lansing at 3,106-66 ft. was 2,430 ft. of oil and no water.

New Norton Pool

Norton County has a new Arbuckle oil pool at Berry & Fick 1 Baird, NE NW SW 13-5s-21w. The discovery well pumped 152 bbl. of oil in 36 hours from open hole in the Arbuckle at 3,545-52 ft. The new pool is 2 miles north of Ray pool.

New Harper Pool Waits For Potential Test

Frank Purcell and J. A. Mull, Jr., have a new pool in Harper County, southern Kansas.

The 1 Dickson, NE NE NW 8-31s-8w, 1½ miles northeast of Grabs pool, gaged a flow of 12 bbl. of oil per hour from the Mississippian.

Pratt County Wildcat Flows on Lansing Test

Lario Oil & Gas Co. 1 Shriver estate, NW SW SE 12-29s-14w, 2 miles north of Coats pool, Pratt County, flowed gas in 7 minutes on drill-stem test in the Lansing lime at 4,307-41 ft. The well flowed oil in 15 minutes. Gas volume was gaged at 3,120 M.c.f. per day. The volume increased until the end of the drill-stem test.

Important Reno Strike

M. B. Armer has either an extension to Sankey Southwest pool or a new discovery of importance at 1 Parrett, NE NW NW 28-22s-10w, Reno County.

The semi-wildcat flowed 90 bbl. of oil natural in 80 minutes from the Viola lime. The 2 Parrett, SW NW NW 28, is drilling.

New State Pools

Four new pools were recently opened in Kansas in three different counties. In southern Kansas Beardmore Drilling Co. opened Berg pool at 1 Berg, SW SW SE 29-32s-7w, Harper County, with a pump potential of 134 bbl. of oil per day from the Viola.

At the southwestern edge of the Central Kansas uplift in Pratt County, A. G. Hill completed 1 Dodson, SE SE NW 21-26s-13w, with a potential of 168 bbl. of oil per day from the Simpson. Buffalo Oil and GMR Oil Co. have a new pool, Lion Northeast, at 1 Lion "C," SE SE NW 21-27s-11w, Pratt County. Pump potential is 355 bbl. daily from the Lansing lime.

On the Central Kansas uplift Petroleum, Inc., completed 1 Malone "C," SW NW SW 25-20s-10w, Rice County, with a pump potential of 25 bbl. of oil per day from the Lansing lime.

OKLAHOMA

New Pay Indicated at Tillman County Pool

A deeper pay zone is indicated at new North Victory pool in Tillman County, southwestern Oklahoma.

Union Oil Co. of California 3 Emenhiser, NE SE NE 23-3s-17w, recovered 43 ft. of free oil and 92 ft. of slightly mud-cut oil with no water in the basal part of the Strawn (Pennsylvanian). The drill-stem test was taken at 4,940-49 ft., open 2 hours

Arrow points to new North Victory pool, recently opened by Union Oil Co. of California.

North Victory pool was opened at Onion 2 Emenhiser, NW SE NE 23-3s-17w, earlier this year. Pump gage was 80 bbl. of oil per day from the Cisco (Permo-Pennsylvanian) at 3,046-52 ft. The 3 Emenhiser also found the Cisco pay. A drill-stem test at 3,063-69 ft. of free oil, 110 ft. of heavily oil and gas-cut mud, and 5 ft. of oil and gas-cut salt water.

In January Union drilled the 1 Jones, SW SW NE 4-4s-16w, 5 miles southeast of North Victory pool, and found good showings in the basal part of the Strawn, but later testing found the zone not of commercial caliber, and the test was abandoned.

Good Play Reported At Southwest Bradley

Southeastern Grady County's Southeast Bradley pool reports an increase in development work. Max Pray 1 Jones, C SE NE 22-4n-5w, is a new south stepout planned, as is the 1 Gosnell-Sinclair, C NW SW 24. The wells will go to 10,500 ft.

Magnolia Petroleum Co. has staked 1 Daugherty, NW NW SW 1, ½ mile north of field production, and off the west edge of the field, Magnolia will drill 1 Baugman, C SW SW 12. Magnolia 1 Burkes-Welch

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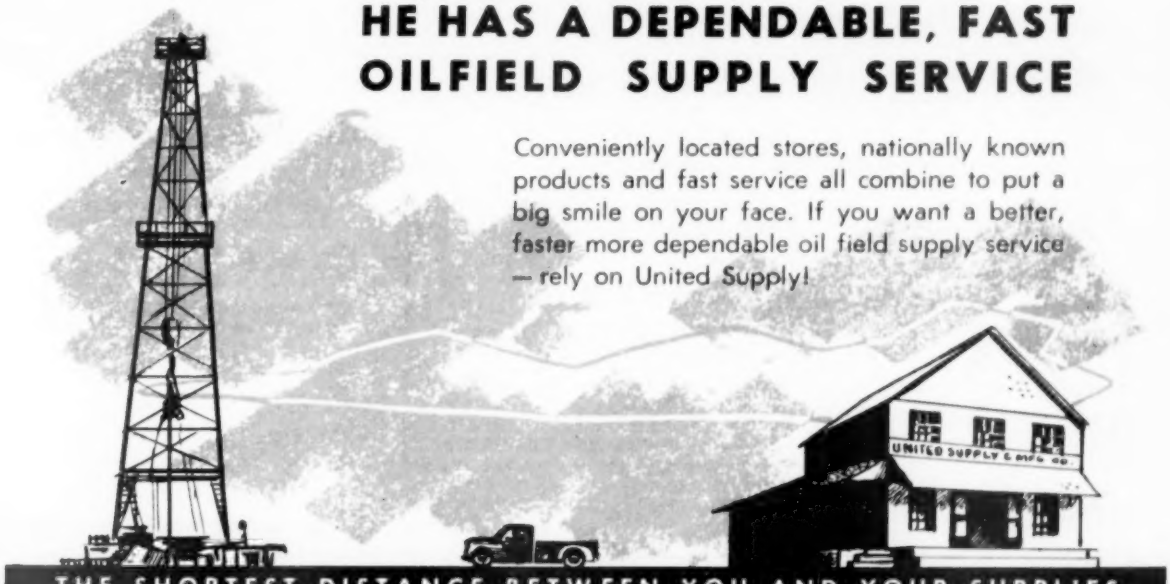

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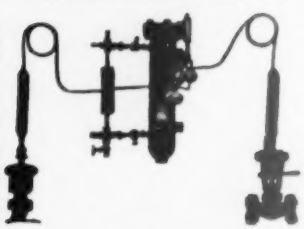
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Unit, W½ SE NW 12, flowed 262 bbl. of oil in 24 hours through 14/64-in. choke on test of perforations at 9,360-68 ft.

The Hart sand pool was opened in the C NW NW 13 in 1952; Springer sand production was opened in January at C NW SE 14.

Cromwell Oil Found At Hughes County Test

Ed Stewart 1 Hinkle, SE NE SE 21-8n-10e, Hughes County, flowed 2,000 M.c.f. of gas per day and recovered 60 ft. of oil and 90 ft. of heavily oil-cut mud on drill-stem test in the Cromwell. The operator has set casing for production tests.

The Gilcrease sand also had shows of gas. The wildcat is ⅜-mile north of Southwest Yeager pool, a one-well gas pool. It is 1 mile northwest of Greasy Creek district production.

In the development area east of Holdenville Hall-Troup et al 1 Rodgers, SE SW SE 8-7n-9e, flowed 202 bbl. of new oil in 5 hours after fracturing of Booch sand pay.

Third Well in East Noble Being Finaled

Carter Oil Co. is adding the third well to East Noble pool, Cleveland County.

Carter's first try in the pool, the 1 Lottie M. Hobaugh, SE SE SW 30-8n-1w, flowed 419 bbl. of oil in 8 hours through 29/64-in. choke with 429 M.c.f. of gas from perforations at 7,894-98 and 7,876-88 ft. in the Bromide sand. The well is east of the discovery well, Pure Oil Co. 1 Hobaugh, SE SW SW 30, which flowed 441 bbl. of oil in 24 hours through 14/64-in. choke from Tulip Creek perforations. The west offset, second well in the new pool, completed for 445 bbl. of oil through 16/64-in. choke. The north and south offsets drilled by Pure Oil Co. were both dry.

Gas-Condensate Pool Opened in Garvin

Max Pray 1 Eason, C SW SW 26-3n-4w, Garvin County, is a new gas-condensate discovery near Purdy.

The Hart sand discovery flowed about 5 bbl. of distillate per hour with 2,000 M.c.f. of gas per day. The new pool is 2 miles southwest of Northeast Purdy pool, an active Hart sand and Springer sand producing area.

High Flow Rate Reported At Centrahoma Pool Well

Carter Oil Co. has completed 1 Centrahoma Townsite, NE SE SW 27-2n-9e, Centrahoma pool well in Coal County, establishing a high flow rate.

The well flowed 366 bbl. of oil in 5 hours in the basal Oil Creek sand on ⅜-in. choke.

Gas-Distillate Flow Recorded at Beckham Test

Herman Brown 1 Ham, C NE NW 25-10n-26w, Beckham County discovery, produced distillate at the rate of 32 bbl. per day through ½-in. choke with 2,830 M.c.f. of gas through perforations at 5,636-46 ft.

The well was taken to 10,294 ft., but plugged back to the perforation depth.

MICHIGAN

Flowing natural at the rate of 5 bbl. of oil an hour from a Reed City-Cato zone pay, and through a highly restricted choke, McClure Oil Co. 1 Kohn, SE SE NW 1-12n-10w, Reynolds Township wildcat, Montcalm County, appeared to be a sure-fire new pool opener for Michigan basin.

Well is bottomed out at 3,345 ft., 98 ft. below the top of the Dundee. Dundee top was logged at 3,251 ft. Pay showed at 3,344-45 ft. Well filled and flowed natural within 1 hour after pay was tapped, but no extended flow tests were made before the tubing was run. While well was being tubed, flow rate averaged 3 bbl. an hour highly restricted, but on a 2-hour test, with flow gate opened only a little more, well averaged 15 bbl. an hour. Operators have estimated that the 1 Kohn would flow as much as 50 bbl. of oil an hour. No water was reported to be showing.

The new Montcalm County discovery well is located about 6 miles northwest of Winfield oil pool, which is being produced from the same horizon; it is from 9 to 10 miles west and north of the Cato, same horizon, field; and approximately 28 miles south and east of Reed City field, Osceola County. Well is also situated on the northwest edge of the Amble Stray sand gas pool, a field which is now designated as a gas storage reservoir. The 1 Kohn is situated in the approximate center of a 4,000-acre drilling block. Well and block is owned by Swan-King Oil Co., Basin Oil Co., McClure Oil Co. and others. Operators plan to move to the south 40-acre offset to the 1 Kohn, SE NE SW 1-12n-10w, for the first follow-up test in the area.

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The W. C. Taggart 3 Wilson-Buers, NW SE SW 1-1s-7e, Salem Township, Washtenaw County, ½ mile west of the 1 LeMaster Trenton oil discovery well, was reported to have been completed in this same horizon, at 4,224 ft., total depth, good for 5,350,000 cu. ft. of gas a day after a 2,000-gal. acid treatment. No oil was reported showing.

CANADA

Pay Zone Indicated at Iroquois River Test

Great Plains and Triad have indicated about 25 ft. of oil pay zone in an unidentified formation believed to be in the Basal Devonian, at a wildcat in the Iroquois River area of northwest Alberta, that earlier this week discovered light-gravity crude.

Second drill-stem test in the productive horizon again flowed 39°-gravity oil, but salt water was also obtained in the bottom of the pipe when it was pulled. The well is now coring ahead.

This discovery well, Great Plains-Triad-Muskeg 1-9 Gilwood, LSD 1, 9-73-18w5, is 10 miles northeast of the Stanolind 1 Little Smoky dry hole, 32 miles northeast of Sturgeon Lake D3 oil wells, 63 miles south of Peace River town and 170 miles northwest of Edmonton.

Most recent drill-stem test in the discovery horizon (a formation that had not indicated commercial oil production at any other previous wildcats) was run from 8,109-8,125 ft., for 2 hours, using a 2,000-ft. water cushion. The water cushion reached the surface in 71 minutes and oil flowed in 103 minutes. Pipe recovery consisted of 6,190 ft. of oil and 720 ft. of salt water. Previous test, from 8,095-8,110 ft., flowed oil in 48 minutes, and recovery was all clean oil, no water.

Little Smoky River . . . A large flow of natural gas and an indicated noncommercial showing of crude oil has been struck at Canadian Gulf Oil Co.'s current driller in the Little Smoky River sector of the Sturgeon Lake region in northwest Alberta, it was reliably reported.

This well, Gulf 10-27 Little Smoky, LSD 10, 27-67-22w5, is ½ mile east of Gulf 12 Little Smoky wildcat that discovered D3 Devonian oil late last year, but was abandoned as noncommercial, and about 9 miles south of Amerada D3 oil wells in the southern portion of Sturgeon Lake field. It lies 170 miles northwest of Edmonton and 90 miles south of Peace River town.

The No. 10-27 venture found its gas in the Permo-Pennsylvanian formation, during 1½-hour drill-stem test from 5,705-23 ft. Natural gas flowed in 3 minutes at rate 8,170,000 cu. ft. daily and oil sprayed in about 35 minutes. Pipe recovery was only a few feet of oil. It is understood that a drill-stem test run a few feet lower gave up formation water. The well will be taken down to test its main objective, the D3 zone of Devonian.

Frobisher area . . . Production test operations are under way at the Frobisher area gas and oil discovery well in southeast Saskatchewan. The oil-water interface has been entered, and indications are that some 12 ft. of oil zone is present below the gas cap. Total effective gas and oil pay appears to be approximately 24 ft.

The well, drilled by Canadian Gulf Oil Co. on a 98,400 acre permit farmout from Canadian Devonian Petroleums, Ltd., Canadian Gulf-Canadian Devonian-Quinn 9, LSD 9, 34-3-4w2, is owned 50-50 by the two companies.

The Quinn well is 3 miles northwest of Frobisher, 23 miles northeast of Estevan and 17 miles north of the United States border. Most recent drill-stem test was run from 4,655-4,660 ft. for about 12 hours. Gas flowed in 3 minutes and oil in 42 minutes, the oil flow was continued for a total of over 11 hours, through various size chokes. Some salt water was recovered when pipe was pulled, and it is believed that the bottom 3 to 3½ ft. of Mississippian was water bearing. Crew is currently squeeze-cementing that section prior to production testing the discovery, Canadian Devonian reported.

The Mission Canyon horizon in the Mississippian was topped at 4,615 ft., or 2,680 ft. below sea level, and the first drill-stem test in the pay zone, from 4,622-35 ft., flowed gas at rate 6,250,000 cu. ft. daily. Pipe recovery was 10 ft. of condensate. It is understood that about 2 ft. of pay zone was open during that test, according to reports from Canadian Devonian Petroleums.

A test from 4,635-45 ft. flowed gas at maximum rate 10,000,000 cu. ft. daily and also yielded a recovery of condensate, or high gravity crude oil. First test to give a flow of oil (gravity of about 40°), was from 4,645-55 ft. that test flowed 55 barrels in 30 minutes.

North Brazeau . . . A six company team of oil exploration companies has found a showing of oil in the Belly River sand at its wildcat in the North Brazeau area of central Alberta, 42 miles northwest of Rocky Mountain House.

The slight encouragement was obtained at Federated et al 1 Sylvester Creek, on LSD 11, 30-43-12w5, which is about 38 miles southwest of Cardium sand oil production in the Pembina region and 28 miles west of the New Superior et al 10-27 Rocky Mountain House wildcat that is being prepared for evaluation tests in the Cardium sand.

First encouragement came during test from 5,032-56 ft., valve open 60 minutes. There was a good initial puff, light air blow decreasing to zero and recovery was 130 ft. of mud slightly gassy and heavily oil-cut at the bottom, and 9 ft. of free oil. Tests down to 5,119 ft. gave up varying amounts of oil and gas-cut mud. Most recent test, from 5,150-87 ft. for 1 hour, gave a good initial puff, a fair air blow for 10 minutes, gradually decreasing to almost nil. Recovery was 100 ft. of heavily gasified and oil-cut mud. Drilling is now proceeding below 5,397 ft.

EASTERN CANADA

Ontario . . . In the Wardsville area, near the Elgin-Middlesex County line, Anchor Petroleums 2 has been completed with 140,000 cu. ft. open flow from the Guelph-Niagara formation. The well has been connected with the Dominion Natural Gas Co. gathering system. Anchor 3 is drilling in the same general area.

In Essex County, extensive leasing is being carried on by Imperial Oil and Calvan Consolidated Oil & Gas Co. The latter company having also taken over some 365 leases secured by Elgin Oil and Gas Prospecting Co. The leases are spread over eight different townships, and it is indicated that drilling will be started this year.

Gaspe . . . In the Gaspe Peninsula, Quebec Province, the 1 asphalt base 1, making oil from 1,196-1,202 ft., has practically completed drilling up a lost bailer and is preparing to start new hole from 2,055 ft.

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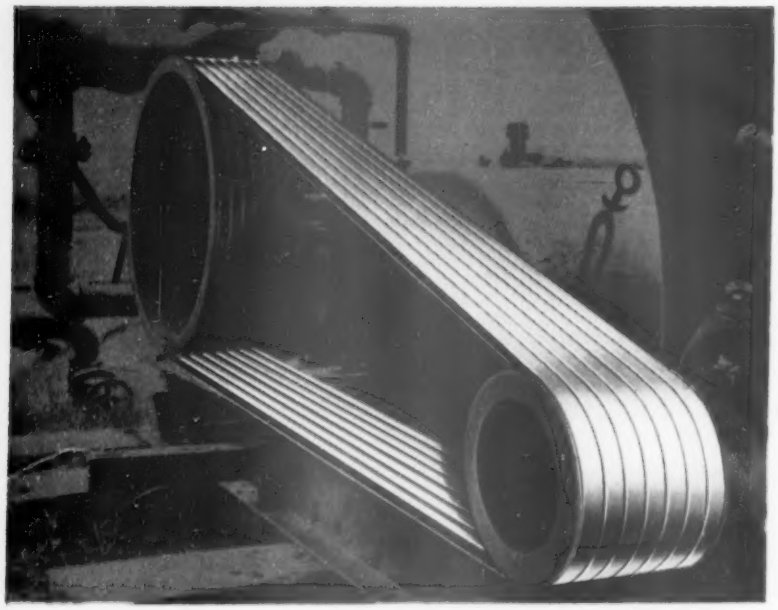

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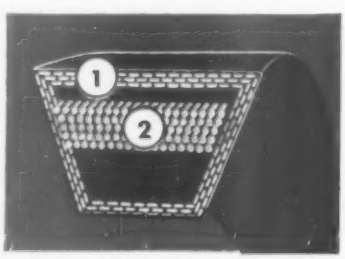

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CALIFORNIA

Monterey Completes Second Newport Offshore Well

Monterey Oil Co. has suspended development of the oil pool it discovered lying offshore from Newport Beach after completing the second well for approximately 100 bbl. daily, pumping. Evidently disappointed by the well's poor showing, Monterey has declared the halt so that further study can be devoted to the pool's prospects.

Newport Beach 2 was completed through perforations at the drilled depths of 3,827-3,927 ft. Prior to redrilling to the 3,927 ft. depth, hole had been drilled to 7,210 ft. Gravity of the produced crude was about 20°. The discovery well, completed last December, was a 250-bbl. producer.

Elk Hills Carneros Test

Standard Oil Co. of California, as operator for the Navy Department, was preparing to test potentialities of the Carneros zone lower Miocene, at a well in the western portion of Elk Hills field. The test, 515 29R, is ½-mile east stepout to the discovery well in NW SE 30-30s-23e. Drilled to 9,245 ft., 7-in. casing was to be run to bottom. A lower finger of the Carneros, topped at 8,930 ft., was to be tested at 9,196-9,230 ft.

Step-Outs Staked for Two Central Valley Pools

Stepouts have been staked to two oil discoveries recorded last December near Bakersfield in central San Joaquin Valley. At Greenacres, which now has three producers, Standard Oil Co. of California, staked a ½-mile east step-out. At Old River, Superior Oil Co. moved two locations west after completing a similar extension to its discovery.

The Standard wildcat will be in 20-29s-27e. In NE SW 19, Trico Oil & Gas Co. completed 2 Billington as a north offset to the discovery, flowing and pumping about 175 bbl. of 20°-gravity crude from the Lerdo sand at 4,387-4,417 ft. Superior's test will be 11 K.C.L. in NW NW 36-30s-26e. Its 31 K.C.L. was completed flowing at a daily rate of 240 bbl. through 9/64-in. choke with perforations at 8,096-8,101 ft.

Oxnard Discovery Offset

Lloyd Corp., Ltd., was preparing to start a north offset to the 10,000-ft. Sespe discovery it recorded at Oxnard field, Ventura County. The new test, which like the discovery is a joint operation with Standard Oil Co. of California, is 1 Lloyd Corp.-Borchard in 31-2n-21w. The discovery flowed about 600 bbl. of 32°-gravity crude through a 16/64-in. choke.

ILLINOIS

Valley Drilling Co. has completed 1 Seal, NW NE NW 15-6s-10e, White County, for 144 bbl. of oil per day after acidization from the Rosiclare lime at 3,034-43 ft. The discovery is 6 miles southeast of Carmi.

In Effingham County Marion Partlow and C. R. Cochonour have set casing at 1 Trustees of Lucas Township School District, NE NW SW 11-6n-6e, 10 miles south of Effingham, and more than a mile from other production. A drill-stem test for 1 hour in the McClosky

lime recovered 1,820 ft. of clean oil, 20 ft. oil-cut mud, no water.

Affeld Oil Co. 1 Collum, SW SW SW 17-5n-12w, is pumping and flowing more than 200 bbl. of oil per day from Cypress sand at 1,476-84 ft. The Crawford County wildcat is more than 5 miles from Cypress production, about 10 miles south of Robinson.

ROCKY MOUNTAIN

COLORADO

Oil Tested at Dove Creek Well

Three States Natural Gas Co. has reported recovery of oil at the rate of 142 bbl. per day at 2 White, C SE SE 33-39n-19w in the Dove Creek area, Montezuma County. The well is the first to be drilled in the area for several years. Discovery was made in 1948, and four wells have since been suspended at various depths in the field. No market outlet has existed. Oil recovered at the current well was from the Paradox (Pennsylvanian) interval 6,140-70 ft., and is 48° gravity. The discovery well produced at the rate of 20 bbl. per hour, but this rate later declined considerably. However, sustained production and full evaluation has not been possible.

South Adena Wildcat is Apparent Discovery

Sunbeam Oil Co., Brush, Colo., is running casing at 1 State, NE NW NW 35-1n-58w, Morgan County. The well flowed oil after 1 hour on drill-stem test of the zone 5,895-5,903 ft. The operator cored 11 ft. of apparently productive sand below this zone, but did not test the cored interval before running casing. The well is about 2 miles south of production at Adena. Seven additional locations have been made in the area by this operator.

WYOMING

Northwest Sheldon Dome Discovery Completed

Skelly Oil Co. has completed 1 Tribal, SW SW SW 36-6n-3w (WRM) in the Northwest Sheldon Dome area of Fremont County for a pump gage of 231 bbl. of 29°-gravity oil per day. Production in the discovery is from two zones in Curtis sand at 3,265-95 and 3,307-17 ft. It is about 4 miles northwest of previous production. Skelly is already near total depth with an attempted confirmation ¼ mile to the northeast.

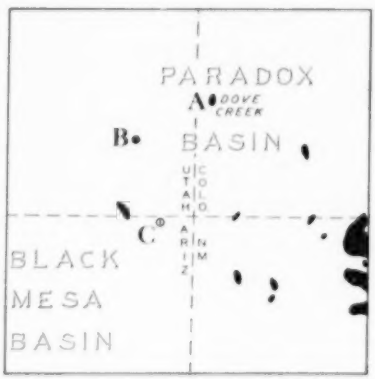
Lakota Gas Recovered At Beaver Creek

Stanolind Oil & Gas Co. recovered gas at the rate of 1,309,000 cu. ft. per day on test of the Lakota interval 8,283-8,366 ft. at 31 Unit, C NW NW 15-33n-96w, in Beaver Creek field, Fremont County. Top of Lakota was found at 8,284 ft. While the operator has not announced intention to complete in Lakota, a completion in this formation would establish the seventh producing horizon for the field.

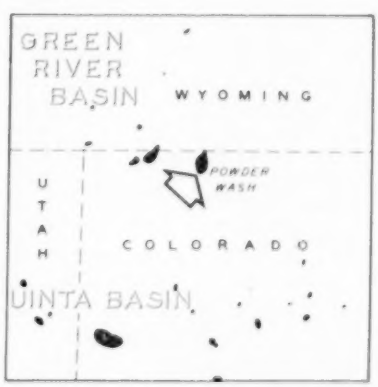
Dakota Discovery Reported In Niobrara County

Unofficial and unconfirmed reports of recovery of oil from Dakota in northern Niobrara County about 11 miles south of previously existing production in Newcastle sandstone have brought new interest to the area. Great Basin Petroleum, Inc., of Denver is credited with recovery of some free oil and a considerable amount of water at 41-7 Government, C SW SW 7-38n-65w. The operator has released no information and made no comment on reports in circulation, but is reported running casing. There is no production from this formation north of Lance Creek and North Ant Hills on the east side of the Powder River basin, with the exception of small production found in Donkey Creek, Campbell County in 1953.

The California Co. is coring below 9,975 ft. at 4 UPRR, C NE SW 1-7n-67w, Black Hollow field extension in Weld County (A on map). At this depth the test is 1,000 ft. below the pay zone of the field, which is the Lyons sand (Permian). Sunbeam Oil Co. is running casing at 1 State, NE NW NW 35-1n-58w, 2 miles southwest of Adena field, Morgan County (B on map).



Three States Natural Gas Co. reported a flow of 142 bbl. of 48°-gravity oil per day at 2 White, Dove Creek field, Montezuma County (A on map). Three States 1 Utah State, Bluff unit wildcat in San Juan County, Utah (B on map) is shut in after swabbing 30 bbl. of oil per day. Shell Oil Co. is continuing tests through the Hermosa (Pennsylvanian) at 1 Navajo, indicated first producer for Arizona (C on map). The wildcat is located in the East Boundary Butte area of Apache County.



Mountain Fuel Supply Co. is testing at its Powder Wash extension after recovering gas at the rate of 10,400 M.c.f. per day.

New Drilling Scheduled At North Fork

Stanolind Oil & Gas Co. has completed unitization of its 1,953-acre block in the North Fork area, Johnson County. Development drilling is scheduled to commence at an early date. Stanolind drilled a Tensleep discovery at 1 Government-Mains, C SW SW 19-44n-81w in 1951, but has done no further work since completion of the discovery. The well was completed for a gage of 173 bbl. of 21.1°-gravity of oil per day. The pool is about 20 miles northwest of Sussex.

NORTH DAKOTA

Golden Valley County Deep Test Abandoned

Blackwood & Nichols have abandoned 1 Gilman-Lang, NE SE 15-140n-105w, Golden Valley County, at a total depth of 12,692 ft. The well was one of three in the central portion of the Williston basin in Montana and North Dakota which recently encouraged operations on the basis of seismic information with shows in Mississippian and deeper zones. The 1 Gilman-Lang had shows in Mississippian and in Ordovician.

Apparent Discovery in Bottineau County Shut In

Dakota Drilling Co. has shut in 1 Anderson, SE NW 19-161n-81w, Bottineau County after recovery of 96 bbl. of fluid, 25 per cent water in 24 hours. The well produced from the Madison zone 4,100-06 ft. It is scheduled for further testing in zones above 4,100 ft. The apparent discovery opens a new pool about 15 miles southwest of previous production in Bottineau County.

SOUTH DAKOTA

Buffalo Area Discovery Completed

Shell Oil Co. has completed South Dakota's first oil producer in the Buffalo area of Harding County for a pump gage of 80 bbl. of oil and 200 bbl. of water per day. The well is 1 State-A, SW SE 9-21n-19e and production is from two zones in the Red River (Ordovician). A second well in the area is drilling near critical depth.

NEVADA

Nye County Discovery Drilling In Limestone

Shell Oil Co. is drilling below 7,685 ft. at the apparent discovery in the Eagle Springs area of Nye County. The wildcat, 1 Unit, SE NE NW 35-9n-57e has been widely re-

ported as Nevada's first producer, with oil recovered through a considerable section substantially above present depth. Shell topped limestone at 7,318 ft. and has been drilling interbedded lime, sand and shale since that depth. A small show of oil was recovered on drill-stem test of the interval 7,376-7,408 ft.

MONTANA

North Sidney Wildcat Recovers Madison Oil

Sun Oil, Eramont Petroleum and others have recovered apparently commercial quantities of oil on test of 1 Beagle Land & Livestock, NE SW SW 17-23n-59e in the North Sidney area of Richland County. Tests were in Madison. The wildcat has been watched with much interest since the operators announced several weeks ago that completion would be attempted in this horizon. There is no production at less than 10,000 ft. in the portion of eastern Montana east of the Cedar Creek anticline.

On test of the zone 9,002-62 ft. the North Sidney wildcat produced 48.3 bbl. of oil, 6 bbl. of water and more than 3 bbl. of sediment in 12 hours of swabbing. A later test of the same zone recovered 60 bbl. of oil and 2 of water on 7 hour swab test. The operators are continuing to test. The zone was acidized prior to swabbing.

Several shows have been logged in Mississippian formations through the general eastern Montana area, but previous shows east of Cedar Creek have been noncommercial.

Sun Oil Co. and Phillips Petroleum Co. have run pipe and will test in Madison at 2 Dynneson, C SW SW 29-24n-58e, in the Brorson area of Richland County. This well is about 24 miles northwest of Sidney. It was intended as a confirmation to the discovery at Brorson where production is from Ordovician, but intermediate casing string has been set for full evaluation of Madison shows. The discovery well had shows in this formation which were not tested after pipe was run.

If the well is not commercial in Madison, it will continue to Ordovician.

North Bloomfield Wildcat Swabs Salt Water

Stanolind Oil & Gas Co. recovered only salt water and a small quantity of oil-cut mud on test of 1-E NP, C NE SE 21-20n-52e in the North Bloomfield area of Dawson County. The well recovered some free oil on drill-stem test of Silurian. When the zone 10,448-10,502 ft. was perforated recovery on first swab was 300 ft. of fluid, 10 per cent oil and 90 per cent mud. The well was shut in for 12 hours and later tests recovered only salt water. Top of Silurian was found at 10,395 ft. Stanolind will continue tests.

Cabin Creek Offset Flows

Shell Oil Co. has reported recovery of 99 bbl. of oil in 15½-hour test of Silurian at 34-33 Unit, NW NW SE 33-10n-58e, Cabin Creek area, Fallon County. Test was of the interval 8,357-8,557 ft. with a net of 148 ft. of the zone perforated. Flow was through open tubing, and following acidization of the producing interval.

On previous tests Shell recovered oil at the rate of 111 bbl. per day from the Red River (Ordovician) zone 8,922-9,124 ft. It is the third well drilled in the field. The discovery was credited by the operator with a calculated potential of more than 4,000 bbl. per day from combined Silurian and Ordovician producing zones. The second well started at Cabin Creek is 11-33 Unit, SE NW NW 33- 10n-58e, which went to a total depth of 10,342 ft., and will plug back to test. Shell has made locations for two additional wells in the field. Both will be drilled within the next few months.

ARIZONA

Apache County Wildcat Testing

Shell Oil Co. is running tests at 1 Navajo, C SE SE 6-41n-29e in the northeast corner of Apache County. The operator has reported recovery of gas at rates varying from 100,000 to 1,000,000 cu. ft. per day from Hermosa. Some fluid was recovered on tests, but had a small oil content. The well showed commercial possibilities during drilling but present tests are not termed particularly encouraging. Tests will continue, however.

LOUISIANA

NORTH LOUISIANA

Potential Awaited at Alden Bridge Wildcat

Lion Oil Co. has shut in for tests at 1 Doles, C NW SW SW 29-21n-13w, wildcat 1⅜ miles northwest of Alden Bridge in Bossier Parish.

The discovery flowed 7 bbl. of oil on a 2-hour test through ¼-in. choke from Buckrange perforations at 1,928-34 ft. in an 8-ft. sand section topped by log at 1,925 ft.

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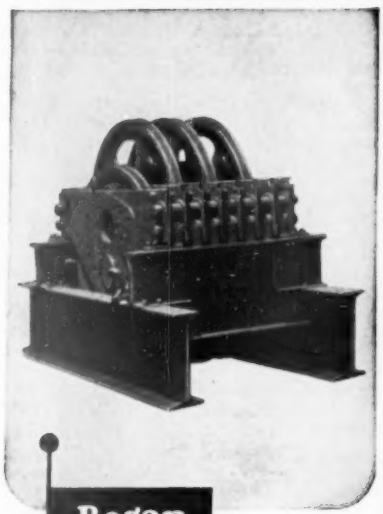

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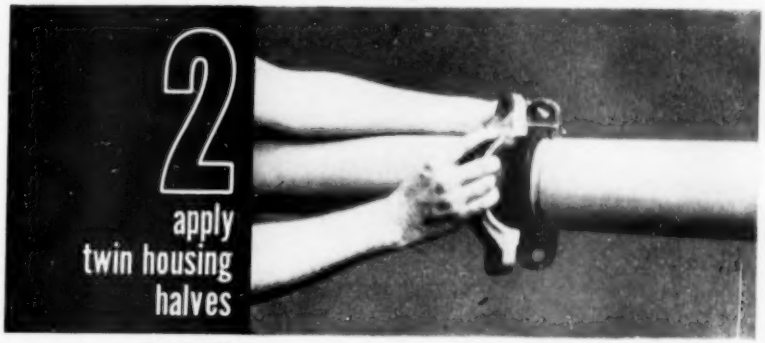

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TEXAS

WEST TEXAS

Cambrian Search Extending Into West Texas Fields

The hottest thing in West Texas drilling continues to be the current search for Cambrian production. Recent successes in fields on the edge of the Eastern platform, geographically designated as West-Central Texas, are now having their effect on drilling in West Texas. Last week three operations already under way in Sutton, Crockett, and Reagan counties announced intentions to penetrate and test the Cambrian formation. These were:

Sutton County . . . Ray Morris 1 Harrison, southeast of Sonora near the southern county boundary, was drilling ahead at 7,654 ft. in dolomite. Top of the Ellenburger was placed at 6,885 ft., by samples. A drill-stem test from 6,605-6,700 ft. developed slightly oil and gas-cut mud, and oil-cut salt water.

Crockett County . . . Magnolia Petroleum Co. 1 Shannon Hospital, 20 miles south of Moreland, had found no shows in the Ellenburger from top at 7,065 ft., but will drill ahead to the Cambrian. At last report it was below 7,861 ft.

Reagan County . . . Phillips Petroleum Co. 1-ZZ University, 9 miles south of Texon, was reported drill-stem testing a dolomite section 750 ft. below top of the Ellenburger, which was picked by samples at 10,200 ft. Tests of the upper Ellenburger had no shows.

Glasco extension . . . Gulf Oil Corp. 1 Butler, west offset to the Glasco-Devonian discovery, has been completed as a good flowing well. A 6-hour drill-stem test in top of the Devonian from 12,554-12,579 ft. produced 549 bbl. of oil with no water.

Meanwhile the north offset, Plymouth Oil Co. 1 Butler, prepared to install pumping equipment for completion. This well found the Devonian only 15 ft. low to the discovery but it was said to be a poor section and has yielded small amounts of oil.

Another Tunstill? . . . Magnolia Petroleum Co. 1-B University, Delaware sand discovery 7 miles northwest of Pyote in Ward County, has logged approximately 54 ft. of pay sand, which is said to be entirely different and much better than other Delaware fields in the basin, with the possible exception of Tunstill field.

Top of the Delaware sand was 4,978 ft. and first water recovery on drill-stem test was between 5,032-44 ft. Of the 54-ft. section, the top 25 ft. carried gas and distillate and the balance showed oil.

Location of this well is near the eastern edge of the Delaware basin. Operators have and are carrying on a steady drilling program in search of Delaware sand oil, and while such production is not spectacular, Tunstill field production amounted to 1,206,000 bbl. in 1953.

NORTH CENTRAL TEXAS

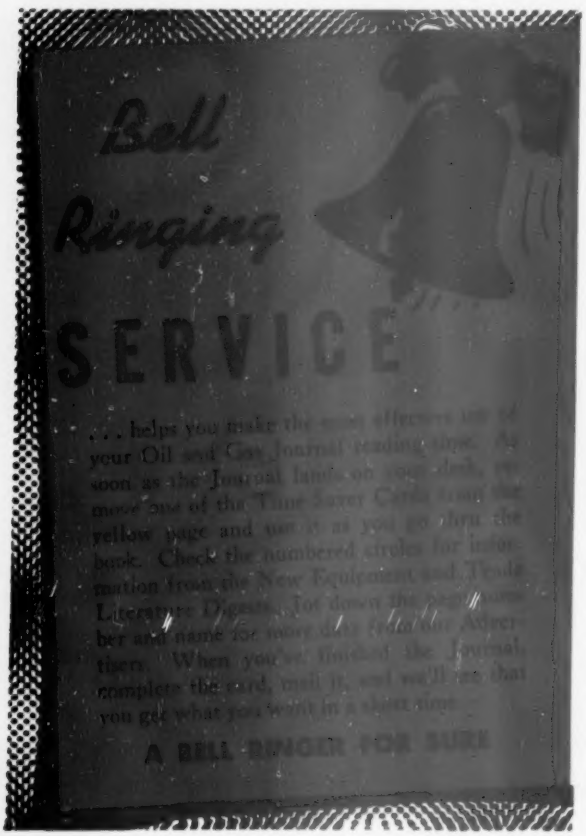
Cambrian Wells Added To New Pools

The North Dora field gained its second and third Cambrian wells, and E. A. (Kilroy) pool had its second producer in sight last week.

At North Dora, The Chicago Corp. 2 TXL flowed 178 bbl. of oil in 3 hours through ½-in. choke, to rate a calculated daily potential of 1,426 bbl. of 47° oil. Pay section was through open hole between 5,965-6,027 ft. Top of the Cambrian was placed at 5,975 ft., minus 3,500 ft. This well is a recompletion, having first been finished as a Caddo pay opener in the field.

Chicago Corp. 1 TXL, original Ellenburger discovery of North Dora, has also been recompleted in the Cambrian, for a daily potential of 828 bbl. of oil. Production was through ⅝-in. choke from open hole at 5,926-6,005 ft. Top of the Cambrian was 6,927 ft., minus 3,558 ft. Datum point on each of these wells is figured from earlier drilling records.

Water in the Cambrian . . . Skelly Oil Co. 4-B Boyd, ½ mile southwest of its recent flush Cambrian well, reported logging 12 ft



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of Caddo pay, 44 ft. of Ellenburger pay, had water in the Cambrian. Operators ran casing to 6,409 ft., total depth.

E. A. field development . . . Seaboard Oil Co. and Continental Oil Co. 1 Jordan, south offset to Kilroy Co. 1 Jordan, had flowing oil in 32 minutes on a test of the Cambrian between 6,074-6,089 ft. The well flowed 4 bbl. of oil in 30 minutes through ¼-in. choke. A second test at 6,089-6,104 ft. flowed 19 bbl. of oil an hour. Following the latter test, operators tested the Ellenburger between 6,044-74 ft. and recovered 20 ft. of oil and gas-cut mud. Top of the Cambrian was figured at minus 3,560 ft.

Humble Oil & Refining Co. 1-NT TXL, west offset to 1 Jordan, developed oil-cut drilling mud and salt water on a test of the Cambrian at 6,126-44 ft. Humble has made location for 2-NT TXL as a south offset to 1-NT.

White Flat field . . . Honolulu Oil Corp. 4 Whitaker has been completed as the sixth Cambrian producer for the field. Calculated daily flowing potential was 498 bbl. of oil a day through 9/32-in. choke, from perforations at 5,600-52 ft.

Fisher County prospect . . . Texas Crude Oil Co. 1 Huddleston developed 680 ft. of oil and 10 ft. of oil-cut mud on a 3-hour test from 5,829-46 ft. Current call on the section is Ellenburger, but last week operators said there was a possibility of its being in the Wilberns.

SOUTHWEST TEXAS

Pearsall Wildcat Produces

James M. Anderson has a new oil-discovery well located 11 miles southwest of Pearsall, in Frio County. The well, 1 Hurt, in the A. L. Adams Survey 326, flowed 86 bbl of oil per day through 9/64-in. choke from pay in open hole at 5,667-5,771 ft. Location is 2 miles south of Pearsall field.

New Pay Zone Opened

A deeper oil-productive sand is being opened in East Coastal field, 3 miles north of Sullivan City, in the southwestern corner of Hidalgo County. Discovery well is Union Producing Co. 4 Steinman, which got a recovery of 12 bbl. of oil in a preliminary drill-stem test of perforations at 5,559-69 ft. Location is 933 ft. east of the field's discovery well, 2 Steinman, which produces from perforations at 3,668-72 ft.

Hidalgo County Discovery Tests Gas and Condensate

Heep Oil Corp. appears to have uncovered another gas-condensate field in Hidalgo County where its 1 Mary O'Brien Shary Estate Unit, a wildcat in Lot 53-1, West addition to Sharyland, encountered promising showings in the Frio-Vicksburg section below 6,500 ft.

Two 15-minute drill-stem tests were run in the zone. The first, at 6,601-03 ft., got a gas flow with 1,016-psi. pressure and a recovery of 35 ft. of 58°-gravity condensate. The second, at 6,604-08 ft., had gas with working pressure of 570 psi., and recovered 25 ft. of condensate.

The prospective pay has been passed up for the time being with hole being deepened to its original objective of 8,500 ft.

Location is in the south central part of the county, 8 miles north of Mission, and about the same distance south of Superior Oil Co.'s multipay, gas-condensate producing Monte Christo field, discovered last year.

TEXAS GULF COAST

Third Well Completed in Southeast Tomball Field

The third producer for the recently opened Tomball Southeast field, 6 miles southeast of Tomball, in northern Harris County, was completed last week. It was Newman Brothers Drilling Co. and Geotek Oil Co. 1 Klenk, located north of the discovery well. A flow of 61 bbl. of 37°-gravity pipeline oil per day through 7/64-in. choke was recorded. Pay interval is 5,837-39 ft. as compared with 5,845-47 ft. in the discovery well.

The area's second well, P. R. Rutherford 1 Wilson, completed the previous week, is located southeast of the discovery well. It flowed 118.74 bbl. of 35°-gravity oil daily through 7/64-in. choke. The field was opened late in February by Newman Brothers Drilling Co. and Geotek Oil Co. at their 1 Ziegenhain.

Two dry holes have been drilled, one 3,000 ft. north and the other a location east of the discovery well. Five rigs are running in the immediate area. Pay is Cockfield sand.

New Hardin County Field Gets Third Oil Producer

Completion of the third producer in the new Jimmie Owen field, 9 miles north of Silsbee, in Hardin County, has been reported by American Republics Corp. and Houston Oil Co., joint operators.

The new well, 1 H&TC fee, the first in the field for the above operators, flowed 48.71 bbl. of 36.6°-gravity oil per day through 7/64-in. choke from the First Cockfield sand at 6,424-30 ft.

It is a west offset to the discovery well,

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J. P. Owen 1 Gore, completed last January with production from both the First Cockfield sand, at 6,402-36 ft., and the Second Cockfield sand, at 6,532-35 ft.

The field's second well, J. P. Owen 1 Gore Unit 1-B, completed early in March produces from the First Cockfield sand at 6,430-38 ft. It is 1,500 ft. southeast of the discovery well.

APPALACHIAN AREA

WEST VIRGINIA

Wildcat drilling in West Virginia: McComas district, Cabell County, West Virginia Gas Corp., 5-576 Gill-Porter wildcat reached the Clinton sand at 4,588 ft., Red Medina 4,670-4,775 ft. and shut down at 4,790 ft. The only gas shows in this well were at 3,420 and 3,540 ft., in the Corniferous lime and Oriskany sand. Blue Sulphur district, Greenbrier County, Columbian Carbon Co. 1-1192 C. Witt McClung, is drilling at 6,343 ft. Hamilton district, Nicholas County, Hope Natural Gas Co., has resumed drilling in 9725 Scott Morris and is at 6,893 ft. The 7-in. casing was run at 6,793 ft. Middle Fork district, Randolph County, Bobray Exploration Co. 1 Chester C. Roush, shut down at 1,600 ft., P. C. McKenzie Co. 1 Elk Horn Coal Corp., is drilling at 800 ft. Roaring Creek district, Edwin J. Fitzgerald et al 1 Paul King, shut down at 2,228 ft. Seneca Gas & Oil Co. 1 Thomas J. Cain, drilling at 90 ft., and Nelson W. Taylor 1 M. J. Ford at 1,840 ft.

OHIO

Blackstone and Ebersbach have confirmed the gas pool west of Gnadenhutten by their 2 Charles St. John, Lot 13, Clay Township, Tuscarawas County. Berea sand at 861-896 ft. and 901-905 ft. gaged 750,000 cu. ft. natural.

An additional well at the north end of Layland pool was completed by Dave Shafer et al on 1 H. C. Graham, Section 23, Killbuck Township, Holmes County. Clinton sand at 3,485-3,497 ft. made 40 bbl. in 24 hours after fracturing.

A ¼-mile east extension to Shearer pool was completed on 1 Chester Miller, 2nd Qr., Bethlehem Township, Coshocton County, by National Gas and Oil Corp. Clinton at 3,418-3,466 ft. made 30 bbl. natural and 225 bbl. in 24 hours after fracturing.

KENTUCKY

WESTERN KENTUCKY

William E. Styles 1 Mrs. Addielee Gabhart, 11-P-21, Henderson County, was completed for an initial production of 150 bbl. of oil per day from the McClosky lime at 2,571-78 ft. and 2,624-48 ft. after fracturing.

WILDCAT COMPLETIONS

SOUTHWEST TEXAS

Guadalupe County: W. O. Fortenberry 1 Scull est., Erastus Smith Sur. 6, A-32. Dry. TD 2,670 ft.

Jim Hogg County: K. D. Owen 1-C Carlos Palacios, Block 8, Pippin Subd., El Randada Grant. Dry. TD 3,621 ft.

Medina County: W. L. Hinds 1 Briscoe, J. Schmerber Sur. 5¼. Shut down. TD 1,960 ft.

Nueces County: The Texas Co. 1 Lawrence, Block 20, Roberts & White Subd., Petronilla Ranch, William Gamble Sur., A-130. Dry. TD 8,522 ft.

Wilson County: Superior Oil Co. 1 Merchant, Gasper Flores Sur., A-13. IP 11,700 M.c.f. daily, open-flow potential, perforations 4,283-88 ft. TD 6,272 ft. (New field—Gasper).

TEXAS GULF COAST

Bee County: Producers Corp. of Nevada 1 Bremer, Refugio County School Land Sur., A-284. Dry. TD 4,713 ft.

Brazoria County: Progress Petroleum Co. of Texas 1 Gulf fee, William Robbins Sur., A-123 (Damon Mound area). Dry. TD 6,015 ft.

Colorado County: Fidelity Oil & Royalty Co. 1 Miller et al, E. Tumlinson Sur., A-44 (in Columbus townsite). Dry. TD 9,798 ft.

Robert Mosbacher and Holmes Drilling Co. 1 Stephens, McKeever & Brophy Sur. 26, A-644. Dry. TD 7,018 ft.

Fort Bend County: Pure Oil Co. 1 Knight, Moses Shipman Sur., A-86. Dry. TD 8,512 ft.

Goliad County: McBride Oil & Gas Corp. 1 Sapenter estate, Goliad Farm Lot 19, Range 1. IP 2,850 M.c.f. daily, open-flow potential, perforations 2,837-45 ft. TD 4,600 ft. (New field.)

Hardin County: Trans-Tex Drilling Co. 1 Williams et al, WCRR Sur. 353, A-525. Dry. TD 9,402 ft.

Harris County: Christi, Mitchell & Mitchell 1 Bob Smith fee, Blas Herrera Sur. (Mykawa area). Dry. TD 11,516 ft.

Jackson County: John B. Coffee 1 McDowell estate, W. J. E. Heard Sur., A-31. Dry. TD 6,697 ft.

Salt Dome Production Co. 1 Four Way Ranch et al, Block 26, LaWard Farms. Dry. TD 8,519 ft.

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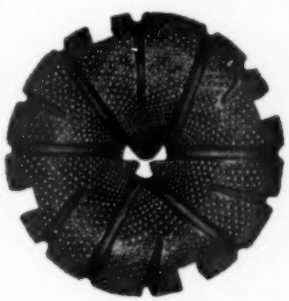

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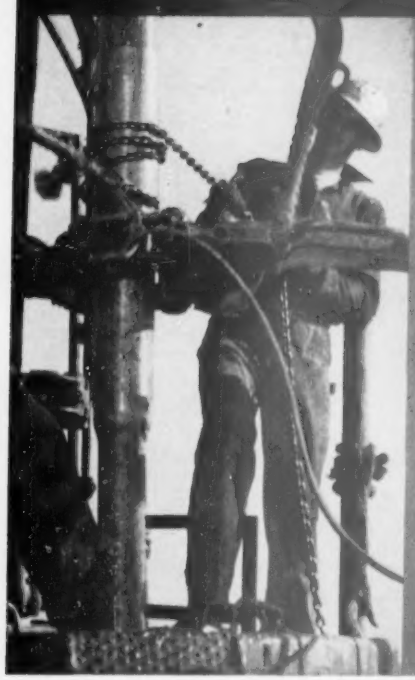

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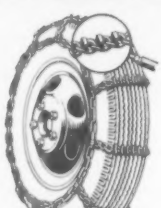
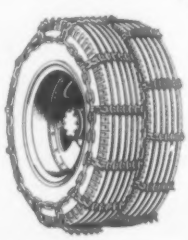


TM V-BAR TIRE CHAINS
V-Bar construction assures total traction—doubles the chain life of ordinary old-fashioned types. Available for passenger cars and trucks (single or dual wheel).



TAYLOR MADE
A GREAT NAME IN Chain SINCE 1873

S. G. TAYLOR CHAIN COMPANY
Hammond, Indiana

WILDCAT COMPLETIONS

South Texas Oil & Gas Co. 1 Wearden et al, I&GN Sur. 17, A-192. IP 250,000 M.c.f. daily, open-flow potential, dry gas, perforatons 3,965-68 ft., and 13,900 M.c.f. daily, open-flow potential, dry gas, perforations 3,741-46½ ft. TD 7,180 ft. (Dual completion.)

Jefferson County: Stanolind Oil & Gas Co. 1-B Marrs McLean, L. Hamshire Sur. 88, A-511. IP 34 BOPD ⅛-in., 39.8°, perforations 11,367-373 ft. TD 12,888 ft. (New field.)

Live Oak County: Appell Oil & Gas Co. 1 Hailey, P. Miller Sur., A-277. Dry. TD 4,363 ft.

Wharton County: Lenoir M. Josey, Inc., 1 Vasek, J. W. Moore Sur., A-44 (North Hungerford area). Dry. TD 7,584 ft.

EAST TEXAS

Harrison County: R. Lacy, Inc. 3 Verhalen Unit, Hiram Blossom Sur. Dry. TD 6,782 ft.

Leon County: Shell Oil Co. 1 Smith, H. Smith Sur., A-799. Dry. TD 7,166 ft.

McLennan County: R. J. Caraway 1 Slaughter, I. Galindo Sur. Dry. TD 2,240 ft.

Van Zandt County: A. R. Graves and Donald Bolls 1 Beard, John Hanks Sur., A-339. Dry. TD 5,446 ft.

TEXAS PANHANDLE

Dallam County: Pamona Corp. 1-A Pritchard, SE NW 16-9-CSS Sur. Dry. TD 6,610 ft. Strat test.

WEST CENTRAL TEXAS

Callahan County: Trumter Petroleum Corp. 2 Williams, Sec. 79, BOA Sur. Dry. TD 2,118 ft.

Coleman County: Clarkson & Wigner 1 Howard, W. H. King Sur. IPP 13 BOPD, pay 2,084 ft. TD 2,126 ft.

Fred Pool Jr. 1 Wilkerson, N. B. Water Sur. 80. Dry. TD 2,584 ft.

Eastland County: Fitzhugh Petroleum Co. 1 McGuire, James Jett Sur. Dry. TD 1,760 ft.

Goble-Shives Drilling Co. 1 Lieske, 80-3-H&TC. Dry. TD 4,000 ft.

Jones County: Burt Oil Co. 1 Young, 45-15-T&P Sur. Dry. TD 2,601 ft.

Ungren & Frazier 1 Tom Parkinson, J. W. B. McFarland Sur. 210. Dry. TD 5,001 ft.

Nolan County: Neville G. Penrose 1 Kirk, W. E. McRory Sur., 1 mile east Blackwell. IP 479 BOPD, 12/64-in., 47°, Wilberns dolomite of Hylton field. Dry. TD 6,890 ft. Elev. 2,408 ft., Canyon reef 4,537 ft., Ellenburger 6,097 ft., Cambrian 6,491 ft., pre-Cambrian 6,869 ft.

Stephens County: J. E. Connally 1 Ledbetter, 82-6-T&P. Dry. TD 3,865 ft.

E. B. Fletcher 1 Curry, 83-6-T&P. Dry. TD 3,669 ft.

NORTH TEXAS

Archer County: Deep Rock Oil Corp. 1 Wedmeyer, Blk. 132, J. W. Harris Subd. Dry. TD 1,400 ft.

Helmerich & Payne 1-B Cox, 1-A7-AB&M Sur. Dry. TD 5,025 ft.

Clay County: K. E. Lee 2 Black, Blk. 93, A-705, WCSL Sur. Dry. TD 4,560 ft.

Jack C. Staley 1 Edrington, W. G. Eustis Sur., A-850. Dry. TD 1,605 ft.

Jack C. Staley 1-B Edrington, BBB&C Sur., A-67. Dry. TD 1,550 ft.

Trans-Tex Drilling Co. 1 Wines, WCRR Sur. 32, A-1088. Dry. TD 5,535 ft.

Foard County: Humble Oil & Refining Co. 3-S Waggoner, 52-B-GH&H. Dry. TD 6,180 ft.

Grayson County: Howell, Holloway & Howell 1 Geddie, A. H. Latimer Sur., A-727. Dry. TD 5,946 ft.

Jack County: Consolidated Oil Co. 1 Edwards, J. Sanchez Sur., Blk. 12, A-516. Dry. TD 3,450 ft.

Davis & Cordner 1 Toney, TE&L Sur. 3325. Dry. TD 292 ft.

Montague County: P-M Drilling Co. 1 Thompson, W. D. Lacy Sur., A-418. Dry. TD 6,966 ft.

Wichita County: Moncrief Eddelman Oil Co. 3 Temple, Blk. 8, Palo Pinto CSL. Dry. TD 1,027 ft.

Ollie Ratliff 6 Smellage, Blk. 13, A-146, H&GN. Dry. TD 400 ft.

Wilbarger County: Fortex Oil Co. 1-C Waggoner, Sec. 3, SPRR Sur. Dry. TD 2,005 ft.

Frank Wood 1 Waggoner "Cherry," 23-4-H&TC. Dry. TD 2,507 ft.

Young County: Pontiac Drilling Co. of Texas 1 Heard, 407-A614-TE&L. Dry. TD 5,223 ft.

Star Oil Co. 1-B Hockaday, L. Gregory Sur., A-121. Dry. TD 4,288 ft.

R. L. Underwood 1 Campbell, Blk. 1371, TE&L Sur., A-860. Dry. TD 1,011 ft.

WEST TEXAS

Crockett County: Thomas Bomar 1 Martin, 15-OP-GC&SF. Dry. TD 1,440 ft.

Wright Cowden 1 University, 36-29-University Lands. Dry. TD 1,942 ft.

Gaines County: Rowan Drilling Co. 1 Stanton-Brunson, Lge. 308, Terrell CSL, 11 miles SE Seminole. IP 1,868 BOPD, ¾-in., 34°, Devonian 12,674 ft. TD 12,796 ft.

Howard County: Joseph I. O'Neill et al 1 Neff, 48-33-T3N-T&P. Dry. TD 8,755 ft. Elev. 2,758 ft., Strawn 6,165 ft.

A. K. Turner 1 Cauble, 32-33-T1S-T&P. Dry. TD 3,276 ft.

Kent County: King Oil Co. 1 Cargile, 25-5-H&GN, 1 mile N Polar. IP 103 BOPD, ¾-in., 39°, Pennsylvanian 7,237-47 ft. TD 7,882 ft.

Lamb County: H. L. Cain 1 Rogers, 18-666-State Capitol Lands, 4 miles E Littlefield. Dry. TD 4,303 ft.

George P. Livermore 1 Chesher, 13-663-State Capitol Lands Sur., 2½ miles W Littlefield. Dry. TD 4,091 ft.

Loving County: Hanlon-Boyle 1 Mission Kyle, 57-1-W&NW, 5 miles E Arno. IP 46 BOPD, 17/64-in., 39°, Delaware 4,463 ft. TD 4,465 ft.

Lubbock County: Amerada Petroleum Corp. 1 Peeples, 133-C-EL&RR. Dry. TD 5,793 ft.

Western Drilling Co. et al 1 Jones, 15-D-L&SV. Dry. TD 6,271 ft.

Pecos County: Metric Petroleum Corp. 1 Will Monroe, 43-1-I&GN. Dry. TD 3,600 ft.

Schleicher County: Atlantic Refining Co. 1 Teele, Sec. 190, HE&WT Sur. Dry. TD 7,658 ft. Elev. estimated 2,384 ft., Strawn lime 7,237 ft., Ellenburger 7,450 ft.

Edwin L. Cox 1 O'Harrow, 60-H-GH&SA. Dry. TD 5,515 ft.

Upton County: Jesse Russell 1 Carney Properties, 2-1-MK&T Sur. Dry. TD 2,532 ft.

Winkler County: Ralph Lowe 1-F University, 37-21-University Lands. Dry. TD 3,330 ft.

SOUTHEAST NEW MEXICO

Lea County: Lawton Oil Corp. 1-A Lowe, 25-11s-37e. Dry. TD 12,517 ft. Elev. 3,921 ft., Pennsylvanian 9,524 ft., Devonian 12,408 ft.

Western Natural Gas Co. 2 Ramco State, 35-16s-35e. IP 103 BOPD on gas lift, 44°, pay 10,440 ft. TD 12,802 ft. New pay in Sho Bar field.

ILLINOIS

Bond County: Dale Hopkins 1 Mills, SE SE SW 33-4n-2w. Dry. TD 1,235 ft.

Hopkins 1 Lilly heirs, SE SW NW 33-4n-2w. Dry. TD 1,225 ft.

Crawford County: J. P. Gaines 1 Kent, SE SE NE 7-5n-10w. Dry. TD 864 ft.

Gaines 2 Kent, NE SE NE 7-5n-10w. Dry. TD 850 ft.

Edwards County: Herndon Drilling Co. 1 Tribe, NEc 23-1s-10e. Dry. TD 3,370 ft.

Jackson County: F. L. Rigney 1 Gutermuth, NEc 26-8s-5w. Dry. TD 1,957 ft.

Lawrence County: Brooks and Allredge 1 Cunningham, NE NW SE 30-2n-12w. Dry. TD 1,715 ft.

Madison County: Arnold Wilson 1 Starkey, NE SW SW 29-6n-8w. Dry. TD 1,281 ft.

Richland County: Paul Hammer 1 Wakefield, SEc 28-5n-9e. Dry. TD 3,149 ft.

Washington County: A. M. Fowley 1 Duerkob SW SE NW 3-1s-4w. Dry. TD 2,327 ft.

E. A. Obering 1 Rennegarbe, NWc 25-1s-4w. Dry. TD 2,660 ft.

White County: Cov Oil Co. 1 Kern-Bennett, SE NW SW 2-5s-10e. Dry. TD 3,185 ft.

INDIANA

Daviess County: Paul F. Ritter 1 Myers, SE SE SE 19-4n-6w. Dry. TD 906 ft.

Pike County: C. L. Trussler 1 Klamer, NE NW SW 35-1n-7w. Dry. TD 2,677 ft.

C. L. Trussler 2 Gray, NW NE SW 35-1n-7w. Dry. TD 2,700 ft.

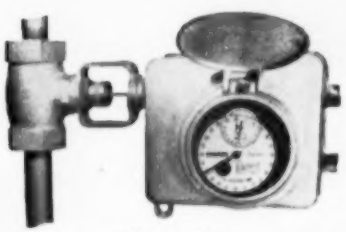
Vigo County: F. B. Cline 1 Stevens-Barrow-Long, NW SE SE 27-10n-8w. Dry. TD 1,944 ft.

Great Lakes Carbon 1 Hartmann, SW NW NW 11-10n-9w. Dry. TD 1,221 ft.

WILDCAT COMPLETIONS

The time you save today is the money you make tomorrow.

Enardo has designed two time cycle switches for your convenience; the model "A" and the model "MB" both are dependable hand wound clock movements, set in cases that are vapor proof, dust proof, and moisture tight; the difference being that the model "A" is a mercoid tube switch and the model "MB" employs an underwriter's laboratory approved micro-switch. They are both designed to shut down your engine at a pre-determined time. Both come in 12 and 24 hour time cycles and have "run-times" of 11 hours on the 12 hour model and 22 hours on the 24 hour model.



MODEL "W"

Enardo has developed another time and money saver called the model "W" clock shut-off valve. It is designed to control the flow of pressures up to 100 PSI of gas or liquid, and to shut off the supply at a pre-determined time. It is particularly adaptable for use on fuel lines to engines. The model "W" clock is manually set and has the same "run-time" as the above models.

MODEL "A"

You will find that these clocks will eliminate a large percentage of return trips. Write Enardo for bulletins 10-01, 10-03, 10-05.

ENARDO manufacturing company

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HOW OIL IS FOUND

By Walter A. Ver Wiebe

Professor of Petroleum Geology at the University of Wichita

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The choicest material available on petroliferous areas is presented. Facts on new methods used to find additional oil pools. Descriptions of more than 50 individual pools and 30 OIL REGIONS from all parts of the world are presented.

Information on rock texture, porosity, permeability, processes of sedimentation is supplied to the reader. Compositions of oil, plants, cycles and their significance are dealt with as well as the most favorable conditions for oil.

Techniques used to find oil deposits are explained fully. Electric logs, micrologs, radioactivity logs, rotary drilling and cable-tool drilling as well as well cuttings and a host of other methods are gone into in detail.

CHAPTERS INCLUDE:

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3. Time and Place of Rock Formations
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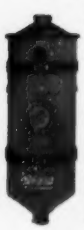
FOR LUBE OILS



EXCEL-SO FILCRON cartridges designed to perform lube oil filtration down to one micron in one pass. Six standard sizes cover all engine horsepowers. Special design disc type cartridge is modified to handle by-pass or full flow problems.

ANY SIZE ANY CAPACITY

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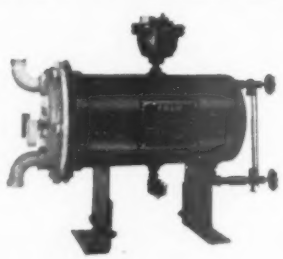

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A Division of FRAM CORPORATION

WILDCAT COMPLETIONS

Warrick County: Walter Sargent 1 Barr, SE SE NW 15-4s-6w. Dry. TD 1,280 ft.

MICHIGAN

Allegan County: Millers Bros. & Cook Drilling Co. 1 Johnston, NW NW SE 15-1n-16w. Dry. TD 1,189 ft. in Traverse lime.

Allegan County: P. K. Degenther 1 Burback & Murback, SE NE SE 33-3n-14w. IPP 1 BOPD, Traverse lime 1,395 ft., TD 1,397 ft. (New pool.)

Charlevoix County: Boyne Oil & Gas Co. 1 Bailey, SE NW NE 14-32n-6w. Dry. TD 1,921 ft. in Richfield.

Clare County: O. H. Kristofferson 1 Frackelton, NE NE SW 17-18n-5w. Dry. TD 3,991 ft. in Dundee.

Jackson County: Balser Cook 1 Schneider, SW NW NE 2-4s-3w. Dry. TD 1,649 ft. in Traverse lime.

Muskegon County: R. W. Devine and J. W. Lang Co. 1 Kundson et al, SW NW NW 11-9n-15w. Dry. TD 1,883 ft. in Traverse lime.

Ottawa County: E. Edwin Brehm and Arthur Scribner 1 DeKleine, SE NE SE 25-5n-14w. Dry. TD 1,700 ft. in Traverse lime.

Washtenaw County: McClure Oil Co. 1 Carlton, NW NW SE 36-4s-3e. Dry. TD 1,433 ft. in Dundee.

WESTERN KENTUCKY

Hopkins County: Felmont Oil Co. 1 Nisket, SE SW SE 16-K-25. Dry. TD 2,920 ft.

McLean County: R. E. Stouder et al 1 Austin, SW SW SE NE 4-L-27. Dry. TD 2,758 ft.

SOUTH LOUISIANA

Cameron Parish: Phillips Petroleum Co. 1-A State Lease 1436-Block 110, Block 40, West Cameron Area, Gulf of Mexico. Dry. TD 11,377 ft.

Union Producing Co. 1 State Lease 2340-Rockefeller, 7-16s-3w. Shutin gas and condensate well, no gage, perforations 13,140-46 ft. TD 13,320 ft. (New pay in, and extends Deep Lake field).

Plaquemines Parish: Richardson & Bass 1-E Humble-Encalade et al Unit "A," 27-17s-14e. Dry. TD 11,891 ft.

Terrebonne Parish: Shell Oil Co. 8 Continental, 33-17s-14e. IP 240 BCPD and 9,160 M.c.f. daily, ¼-in. 56°, perforations 10,336-48 ft. TD 11,550 ft. (New pay in Turtle Bayou field).

FLORIDA

Holmes County: Lyle Cashion Co. et al 1-B Yawkey, C NE NW 1-4n-17w. Dry. TD 4,310 ft. Elev. 86 ft., lower Tuscaloosa 4,137 ft.

ALABAMA

Baldwin County: Union Producing Co. 1 May, 12-1s-2e. Dry. TD 7,504 ft. Elev. 137 ft., Lower Cretaceous 7,430 ft.

MISSISSIPPI

Adams County: Durbin Bond and Peterson Drilling Co. 1 Willard-Butler, 45-6n-1w. Dry. TD 6,715 ft. Elev. 282 ft., Wilcox 4,422 ft., base Baker shale 6,212 ft.

Franklin County: David K. Brooks et al 1 U.S.A., C NW NW 20-5n-1e. Dry. TD 6,992 ft. Elev. 286 ft., Wilcox 4,527 ft., Minter zone 6,600 ft.

Jefferson County: Hunt Oil Co. 1 Johnson, 35-9n-2e. Dry. TD 6,950 ft. Elev. 380 ft., Wilcox 3,891 ft., base Baker shale 5,778 ft.

Madison County: Tip Ray and D. C. Latimer 1 Guillot, 11-7n-1e. Dry. TD 4,022 ft. Elev. 383 ft., Wilcox 1,999 ft., Gas Rock 3,892 ft.

Wayne County: Sunnyland Contracting Co. 1 Board of Supervisors, C SW SE 16-10n-6w. Dry. TD 5,101 ft. Elev. 282 ft., Tuscaloosa 4,762 ft.

NORTH LOUISIANA

Grant Parish: David K. Brooks et al 2 U.S.A., C SE SE 3-7n-1w. Dry. TD 4,800 ft.

ARKANSAS

Lafayette County: W&W Drilling Co. 1 Scantland, C SW NE SW 12-16s-24w. Dry. TD 4,203 ft.

Union County: Pan Am Southern Corp. 1 Daniel estate, C NE NE SW 29-16s-14w. Dry. TD 3,601 ft.

Gaylord Chizum and Ross Producing Co. 1 Smith, C NW NW SW 7-19s-12w. Dry. TD 4,096 ft.

OKLAHOMA

Garfield County: Barnett Oil Co. 1 Pribil, SE SE SE 11-21n-3w. Dry. TD 4,452 ft.

Jackson County: Hopkins Drilling Service 1 Sneed, SE SW NW 1-1n-20w. Dry. TD 1,472 ft.

Lincoln County: N. T. Smith 1 Dinkiness, SE SW NE 35-12n-2e. Dry. TD 5,947 ft.

Mid-Continent Petroleum Corp. 1 Gessman, NW SE SW 28-13n-4e. Dry. TD 4,340 ft.

Logan County: Harper Turner Oil Co. 1 Orner, NW NE NE 26-15n-2w. Dry. TD 6,279 ft.

Noble County: Texas Crude Oil Co. 1 Edwards, SE SE SW 2-24n-1e. Dry. TD 4,706 ft.

Major County: Livon Oil Corp. 1 Reese, NE NE NE 18-21n-11w. IPF 60 BOPD, Cherokee 6,765-82 ft., Mississippi lime 7,303-30 ft., 18/64-in. TD 7,429 ft. (Oil discovery.)

Pawnee County: R. Geer et al 1 Barrier, SE NE NW 22-23n-5e. Dry. TD 3,120 ft.

Payne County: Randall R. Morton 1 Caldwell, SE NE NW 14-18n-2e. Dry. TD 4,838 ft.

Pottawatomie County: Amerada Petroleum Corp. 1 Gish, SW SW NE 27-8n-2e. Dry. TD 5,886 ft.

Seminole County: Kenmitz Drilling Co. et al 1 Collins, SW NE NW 6-5n-6e. IPP 27 BOPD, Senora 2,113-20 ft., 33°, TD 2,260 ft.

KANSAS

Ellis County: Flynn Oil Co. 1 Klaus, NE NE SW 19-15s-18w. Dry. TD 3,635 ft.

Greeley County: Cities Service Oil Co. 1 Sells, NE NE SW 9-18s-40w. Dry. TD 5,320 ft. in Mississippi.

Harper County: Beardmore Drilling Co. 1 Berg, SW SW SE 29-32s-7w. IPP 134 BOPD, Viola 4,758-64 ft., 44°. TD 4,983 ft. (Opens Berg pool.)

Logan County: Gerald Gordon and Wycoff 1 Newcomb, SW SW SW 11-14s-34w. Dry. TD 965 ft.

McPherson County: Musgrove Petroleum 1 Koehn, NE SE SE 8-20s-2w. Dry. TD 3,005 ft.

Norton County: The Texas Co. 1 Reed, SE NE SW 11-4s-24w. Dry. TD 3,865 ft.

Gore-Empire 1 Magill, NE NE SE 12-5s-23w. Dry. TD 3,780 ft.

Pawnee County: Coppinger-Aurora Gasoline 1 Haggerman, SW SW SE 6-20s-17w. Dry. TD 4,070 ft.

Pratt County: GMR and Buffalo Oil 1 Lion "A," SE SE SW 21-27s-11w. IPP 355 BOPD, Lansing 3,796-99 ft. TD 4,515 ft. (Opens Lion Northeast pool.)

Lario Oil & Gas 1 Moon, SW NE SW 13-27s-14w. Dry. TD 4,655 ft.

Russell County: H. T. Manning 1 Michaelis, NW NE SE 17-13s-15w. Dry. TD 3,317 ft.

Berry & Fick 1 Witt, NW NW NW 7-15s-15w. Dry. TD 3,467 ft.

Stafford County: Barnett Oil 1 Justus, SE NW NW 17-22s-11w. Dry. TD 3,696 ft.

Rocket Drilling Co. 1 White, SE SE NE 6-25s-12w. Dry. TD 4,236 ft.

EASTERN NEBRASKA

Richardson County: Leonard Stout Drilling Co. et al 1 Stevens, SE SW SW 24-1n-14e. Dry. TD 2,525 ft.

J. E. Palensky & Sons 2 Meyer, SE NW NW 9-1n-16e. Dry. TD 2,493 ft.

NEBRASKA . . . Western

Cheyenne County: Gilliam Drilling Co. 1 Terman, SW SW SE 29-14n-52w. Dry. TD 5,418 ft.

Dawes County: Shell Oil Co. 1 State, SE SW SE 16-29n-49w. Dry. TD 4,192 ft. in Big Blue.

Kimball County, Dietz: Superior Oil Co. 64-3 Dietz, SE SW NE 3-13n-55w, IPP 99 BOPD, "J" sand discovery, new field. TD 6,381 ft. "J" sand.

Sioux County: McElroy & McElroy, Inc., 1 Nichols, SW SE SE 20-24n-57w. Dry. TD 6,302 ft. in Spearfish.

CALIFORNIA

Colusa County: R. S. Rheem, Oper. 1-31 Davis, 31-18n-1w. Dry. TD 4,025 ft.

Fresno County: Oceanic Oil Co. 31-30 Ponte, 30-13s-17e. Dry. TD 3,839 ft.

Kern County: Berry Holding Co. 83 Portals-Butler, 3-30s-29e. Dry. TD 5,250 ft.

Pacific Western Oil Corp. 1 R-K NE SW 23-30s-21e, IPF 147 BOPD, 41/76-in. Choke, 28° gravity, 23 per cent cut, Perfs. 5,690-5,825 ft., TD 6,010 ft. (New Eocene sand pool in Belgian Anticline field.)

Gene Reid Drilling Co. at al 1 M & T, 31-28s-29e. Dry. bottomed in granite, TD 4,462 ft.

R. S. Rheem, Oper. 1 Glide, 27-27s-28e. Dry. Vedder 1,535 ft., TD 1,610 ft.

Standard Oil Co. of California 7-11 27, 27-28s-27e. Dry. Chanac 2,220 ft., TD 2,550 ft.

Kings County: Norris Oil Co. Co. 52-29 Oceanic-Baylis, NW NE 29-24s-18e, IPP 48 BOPD, 39.3° gravity, perfs. 3,330-3,480 ft. and 4,346-68 ft., TD 4,514 ft. (Approx. ¼-mile southeast extension to Orchard pool of Pyramid Hills field.)

Reserve Oil & Gas Co. 38A-20 Reserve-Orchard, 20-24s-18e. Dry. TD 1,261 ft.

Los Angeles County: Seaboard Oil Co. 53-23 Seaboard, 23-2n-16w. Dry. TD 7,012 ft.

Orange County: Morton & Dolley 1 W.K., 10-6s-11w. Dry. TD 2,712 ft.

J. K. Wadley 1 Segerstrom, 9-6s-10w. Dry. TD 6,563 ft.

Santa Barbara County: A. A. Cameron 31-16 "Well," 16-10n-27w. Dry. TD 4,300 ft.

Ventura County: Lloyd Corp., Ltd. 1 Lloyd Corp., 31-2n-21w, IPF 500 BOPD, 16/64-in. choke, 32° gravity, 1,300 psi. tubing and casing pressure, perfs. 9,988-10,022 ft., TD 10,024 ft. (New deeper Sespe pool discovery in Oxnard field.)

Union Oil Co. 25 Simi, 8-3n-18w. Dry. TD 4,238 ft.

WYOMING

Big Horn County: Ajax Oil Co. 1 Simic-Government, C NE NW 11-49n-92w. Shut down. TD 6,975 ft. in Phosphoria.

Converse County: Couch Drilling Co. 1-C Rogers, NE SW SW 17-31n-69w. Dry. TD 396 ft. in Converse.

(Continued on page 191)

OILFIELD POWER... *built to order!*

It's built *big* to perform bigger jobs. It's built with the heavy-duty construction and moderate-speed design typical of all MM Oilfield Engines . . . with the kind of durability that takes cycle peak loadings in stride.

That's the Minneapolis-Moline 800-6A . . . the new six cylinder engine offering 5 5/16-inch base, 6-inch stroke, and 800 cubic inch piston displacement. With this 800-6A, lower piston speeds for less travel result in longer engine life, long runs, low service and all of the MM continuous-duty advantages which have proved so outstanding in oil industry operations.

Large oil filters submerged in water-jacketed base pan supply cleaner oil to cylinders and bearings at constant temperature, regardless of load or weather conditions. Controlled temperature provides most complete filtering and elimination of sludge. Shafts, bearings, cylinder block, crankcase, base pan, flywheel, clutch and power shafts are engineered for liberal loadings to make the 800-6A the sturdiest engine in its size and price class.

For complete performance facts and engineering data on the new Minneapolis-Moline 800-6A Oilfield Engine, write, call or wire

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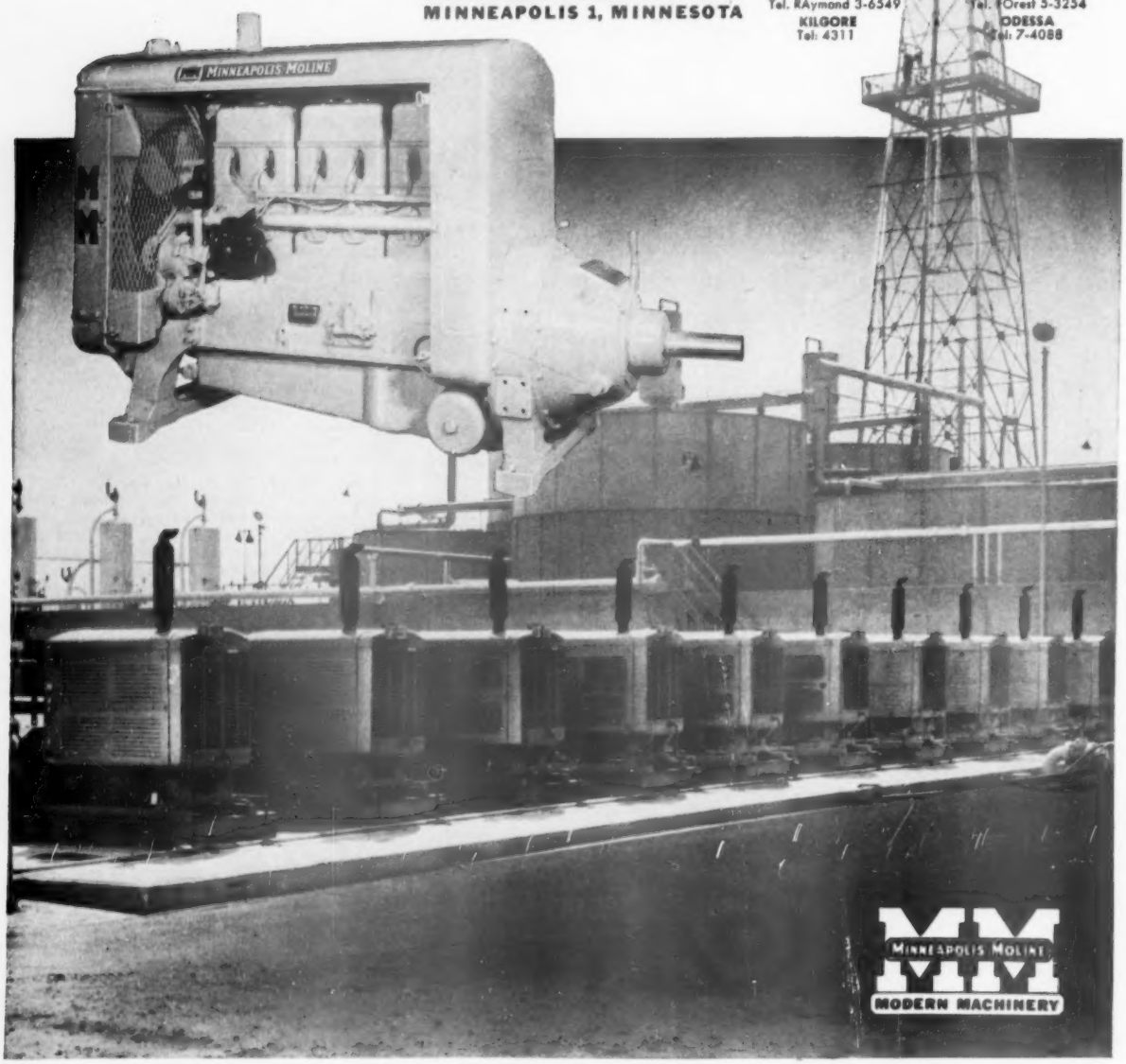
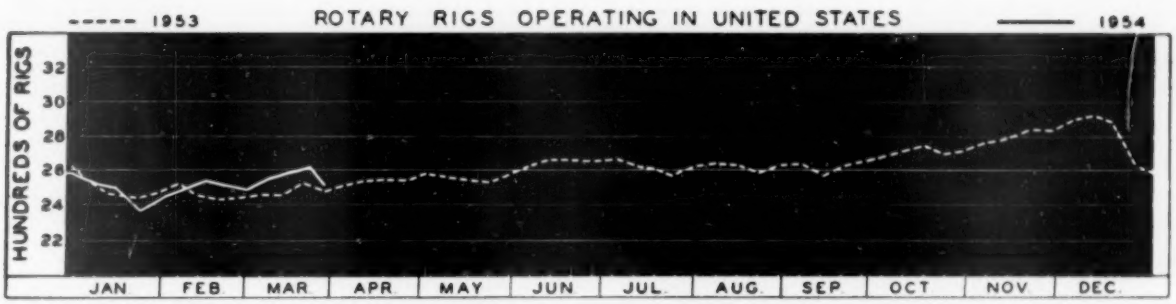
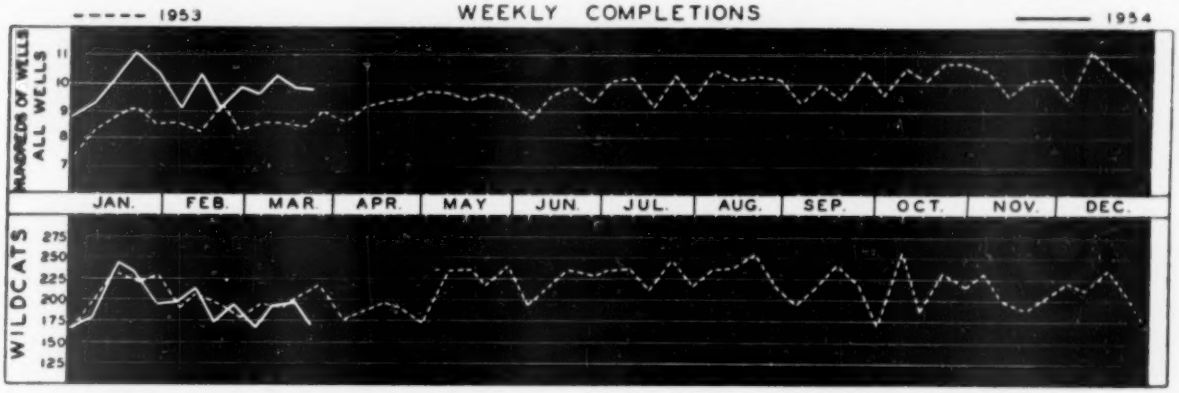






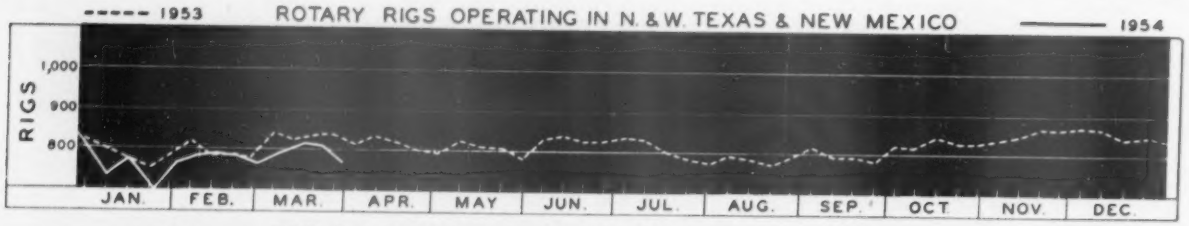
CURRENT STATISTICS

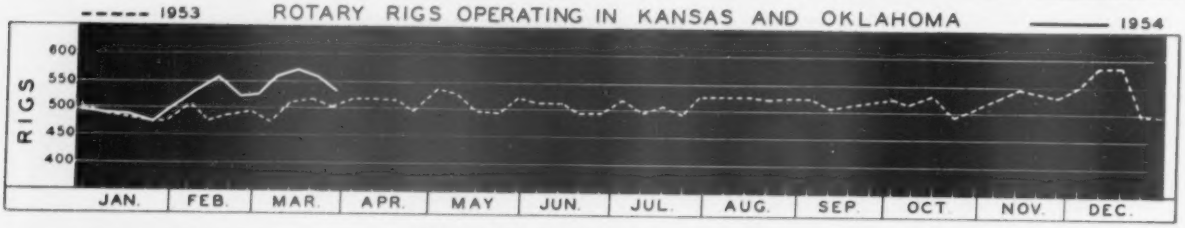
EXPLORATION

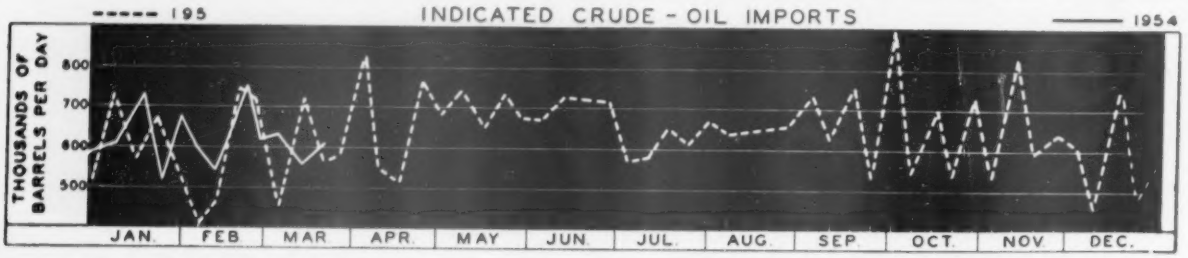
WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 27, 1954

	Total of all wells					Mar. 27		Wildcat completions and discoveries					Cumulative total, 1954				
	Comp.	Oil	Gas	Dry	Footage	1954	1953	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Pennsylvania-New York	50	24	3	*23	79,200	572	534	0	0	0	0	0	0	0	1	8	9
West Virginia	9	0	7	2	29,855	129	117	0	0	0	0	0	0	0	6	4	10
Ohio	23	12	5	†6	35,257	255	233	0	0	0	0	0	0	0	2	1	3
Indiana	20	7	0	13	30,398	179	272	0	0	0	6	6	3	0	0	45	48
Kentucky	15	9	0	6	35,580	253	230	0	0	0	2	2	5	0	0	27	32
Illinois	44	18	0	26	108,771	590	406	0	0	0	12	12	0	0	0	100	100
Michigan	13	4	0	9	34,201	144	126	1	0	0	7	8	1	0	0	65	66
Kansas	90	48	9	‡33	299,061	1,026	1,108	2	0	0	12	14	16	0	4	126	146
Nebraska	9	2	1	6	44,155	85	63	1	0	0	5	6	6	0	0	23	29
Oklahoma	185	121	3	§61	649,656	2,235	1,653	2	0	0	9	11	29	2	7	147	185
Texas	323	187	18	118	1,498,097	4,209	3,969	7	0	1	60	68	171	21	39	951	1,182
North Central (Dist. 7-B & 9)	127	70	2	55	397,100	1,546	1,426	3	0	0	26	29	85	2	5	372	464
West (Dist. 7-C & 8)	64	44	1	19	376,058	968	897	3	0	0	13	16	51	0	6	178	235
Panhandle (Dist. 10)	14	9	3	2	45,829	205	189	0	0	0	1	1	0	0	2	16	18
Eastern (Dist. 5 & 6)	22	12	5	5	105,822	189	201	0	0	0	4	4	5	0	3	51	59
Gulf Coast (Dist. 2 & 3)	62	30	4	28	411,993	687	603	1	0	0	12	13	16	8	11	169	204
Southwest (Dist. 1 & 4)	34	22	3	9	161,295	614	653	0	0	1	4	5	14	11	12	165	202
Louisiana	50	40	3	7	242,329	804	617	0	2	0	3	5	28	14	7	69	118
Northern	33	26	3	4	75,655	419	276	0	0	0	1	1	4	0	1	22	27
Southern	17	14	0	3	166,674	385	341	0	2	0	2	4	24	14	6	47	91
Arkansas	11	6	0	5	36,830	172	112	0	0	0	3	3	7	0	0	23	30
Mississippi	7	1	1	5	42,234	86	88	0	0	0	5	5	2	0	0	32	34
Southeastern States	2	0	0	2	11,814	30	33	0	0	0	2	2	1	0	1	24	26
Montana	6	4	0	2	32,354	70	94	0	0	0	0	0	1	0	0	21	22
Wyoming	39	34	1	4	222,852	375	138	2	0	0	4	6	13	0	2	47	62
Colorado	12	7	0	5	66,052	260	116	0	0	0	4	4	9	0	0	98	107
Utah	1	0	0	1	3,930	16	22	0	0	0	1	1	1	0	0	8	9
New Mexico	16	12	2	2	109,747	293	333	1	0	0	1	2	6	0	1	38	45
California	52	36	1	††15	235,645	583	602	3	0	0	12	15	22	0	5	124	151
North Dakota	1	1	0	0	8,305	50	58	0	0	0	0	0	3	0	0	12	15
Miscellaneous (S. D.)	1	1	0	0	9,335	51	14	1	0	0	0	1	1	0	0	7	8
Total United States	979	574	54	351	3,865,658	12,467	10,938	20	2	1	148	171	325	37	75	2,000	2,437
Total previous week	988	571	70	347	4,147,332			32	3	8	154	197	305	35	74	1,852	2,266
Total March 28, 1953	900	469	72	359	3,734,705			32	1	11	174	218	336	23	92	2,080	2,531

Service wells included: *19, †2, ‡1, §4.







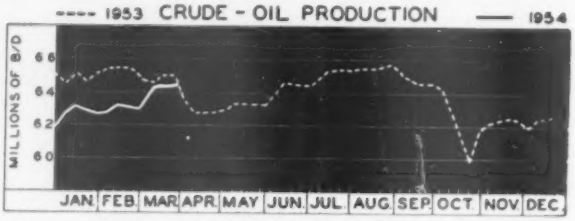
DAILY AVERAGE PRODUCTION FOR WEEK

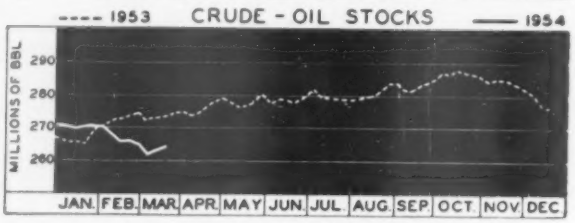
	March 27 Crude oil	March 27 Lease condensate	March 27 Total	Mar. 20 total
Alabama	4,300	.....	4,300	4,200
Arkansas	75,700	550	76,250	75,250
California	994,100	.....	994,100	996,200
Colorado	117,700	.....	117,700	114,700
Eastern	54,500	.....	54,500	54,500
Florida	1,475	.....	1,475	1,475
Illinois	172,000	.....	172,000	174,100
Indiana	29,600	.....	29,600	30,400
Kansas	331,200	.....	331,200	325,600
Kentucky	34,200	.....	34,200	34,400
Louisiana	638,400	48,900	687,300	692,200
North	103,400	3,900	107,300	112,200
South	535,000	45,000	580,000	580,000
Michigan	34,700	.....	34,700	33,900
Mississippi	88,650	3,950	92,600	92,350
Montana	30,000	.....	30,000	29,800
Nebraska	19,100	.....	19,100	18,800
New Mexico	205,700	1,675	207,375	207,575
Oklahoma	513,700	.....	513,700	516,100
Texas	2,730,000	53,000	2,783,000	2,783,000
Dist. 1	43,500	575	44,075	44,075
Dist. 2	144,300	7,900	152,200	152,200
Dist. 3	424,700	25,000	449,700	449,700
Dist. 4	253,700	6,200	259,900	259,900
Dist. 5	47,600	450	48,050	48,050
Dist. 6	117,300	5,800	123,100	123,100
East Texas field	242,000	.....	242,000	242,000
Dist. 7-B	135,400	75	135,475	135,475
Dist. 7-C	175,700	4,750	180,450	180,450
Dist. 8	868,700	1,600	870,300	870,300
Dist. 9	192,000	600	192,600	192,600
Dist. 10	85,100	50	85,150	85,150
Utah	4,900	.....	4,900	4,400
Wyoming	234,900	.....	234,900	231,800
North Dakota	14,600	.....	14,600	14,500
Total U. S.	6,329,425	108,075	6,437,500	6,435,250
Change from previous week,			up 2,250	.....
Canada	226,325	.....	226,325	204,475

Total U. S. production January 1-March 27 ..... 545,697,450 bbl.

Same period last year (crude plus cond.) ..... *563,738,080 bbl.

*Includes 8,069,175 bbl. condensate.



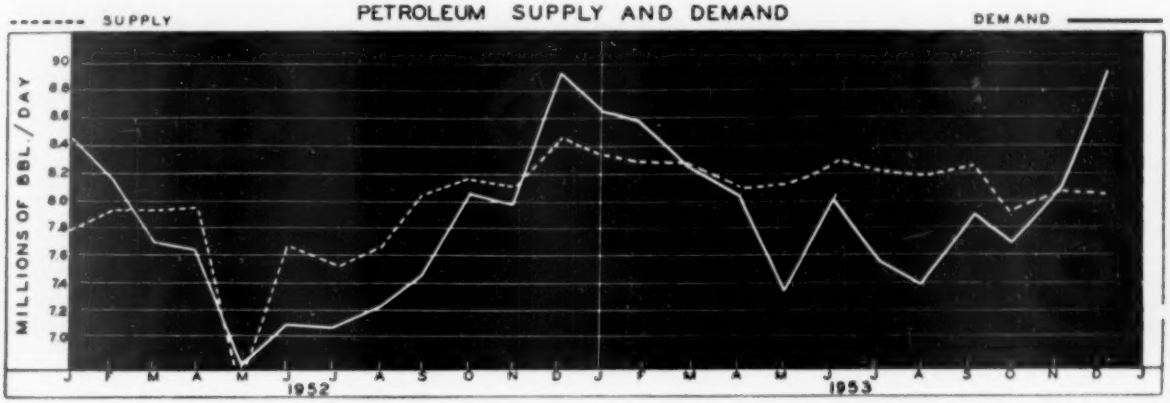


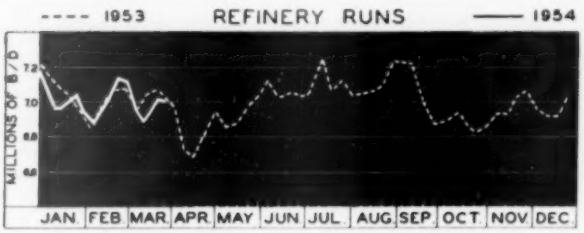
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

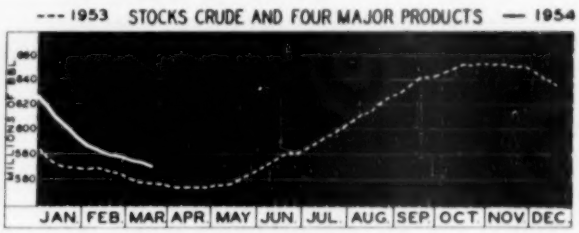
(Thousands of barrels)

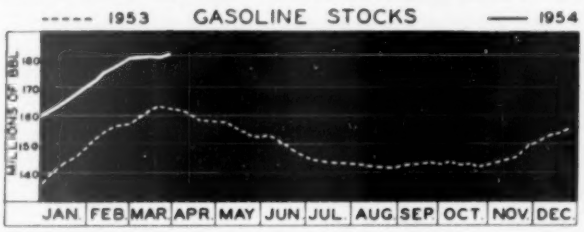
	Mar. 20, '54	Mar. 13, '54	Mar. 21, '53
Pennsylvania Grade	2,740	2,751	2,378
Other Appalachian	1,775	1,709	1,751
Illinois, Indiana, Michigan	11,827	11,549	10,493
Arkansas	3,050	3,061	2,974
Louisiana	14,675	14,441	17,075
North	2,537	2,620	3,224
Gulf	12,138	11,821	13,851
Mississippi	3,304	3,271	3,854
New Mexico	7,254	7,051	7,168
Oklahoma and Kansas	36,655	36,678	36,288
Texas	120,540	120,130	135,934
East Texas	11,187	10,448	11,426
West Texas	51,578	51,513	65,165
Texas Gulf	25,256	24,932	25,978
Other Texas	32,519	33,237	33,365
Rocky Mountain	16,920	16,887	16,124
California	34,439	34,032	32,780
Foreign	†10,719	11,614	7,661
Total	263,898	263,174	274,480

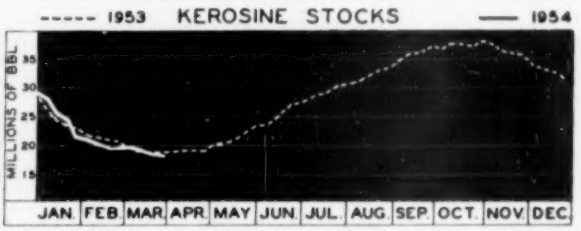
*Bureau of Mines. †Includes 2,776,000 bbl. in California.

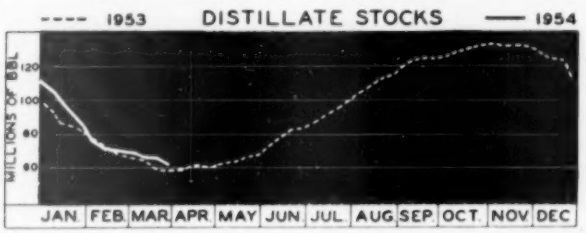


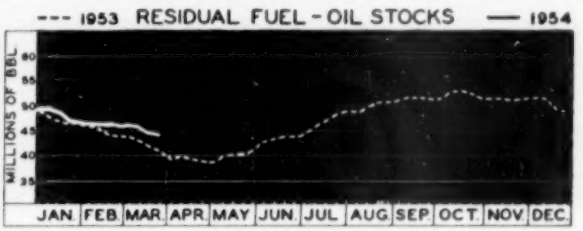










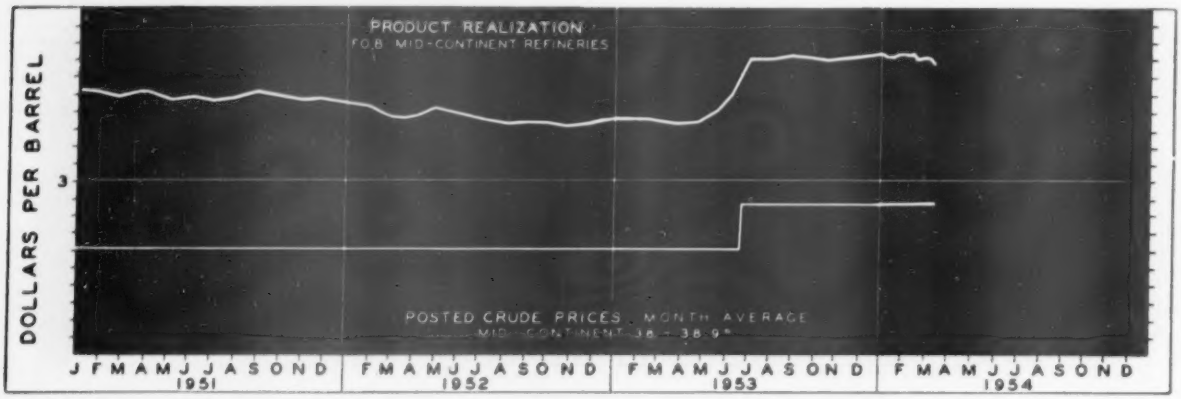


A.P.I. REFINERY REPORT, MARCH 27

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, March 1953 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,039	430.3	17.4	290.7	203.1	36,157	7,649	21,147	9,176	1,044	398.9	36.4	258.5	233.0
Appalachian:														
District 1	85	40.3	4.7	18.6	10.6	4,611	389	961	540	108	43.4	6.6	20.1	15.3
District 2	98	46.9	7.3	17.1	13.3	2,429	360	401	290	96	47.2	7.0	15.4	16.0
Ind., Ill., Ky.	1,291	675.3	74.0	238.2	186.7	39,769	3,708	9,495	4,331	1,241	657.0	71.1	218.0	164.3
Okla., Kans., Mo.	573	346.6	22.1	135.3	43.3	20,421	954	6,103	1,205	576	334.7	13.0	132.7	58.0
Inland Texas	251	166.4	11.3	45.0	29.0	7,071	290	994	1,243	254	164.2	12.3	44.3	33.4
Texas Gulf Coast	1,705	863.0	144.8	393.4	242.2	23,963	2,416	6,197	4,275	1,779	798.2	145.4	428.1	248.1
La. Gulf Coast	555	255.9	60.6	117.3	43.0	9,975	1,138	2,784	1,075	534	269.4	51.3	141.4	49.4
N. La. and Ark.	95	37.6	9.2	25.1	8.7	4,218	513	933	102	79	31.5	7.5	17.6	6.8
Rocky Mountain:														
New Mexico	18	11.3		3.0	2.8	192		59	25	18	10.7	0.5	2.7	4.2
Other Rocky Mtn.	232	110.4	5.0	49.3	42.9	8,221	182	1,819	734	230	106.3	2.4	50.6	42.3
California	1,058	457.3	6.3	148.4	370.3	23,357	390	10,542	21,097	1,043	457.6	5.7	159.5	385.1
Mar. 27, 1954	7,000	3,441.2	362.7	1,481.4	1,195.9	180,384	17,989	61,435	44,093	7,002	3,319.1	359.2	1,448.9	1,255.9
Mar. 20, 1954	7,013	3,351.4	337.8	1,536.8	1,199.8	179,399	18,050	63,341	44,507					
Mar. 28, 1953	7,000	3,237.0	344.4	1,451.3	1,266.1	162,878	18,417	59,757	41,001					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.


PRODUCT REALIZATION
F.O.B. MID-CONTINENT REFINERIES
DOLLARS PER BARREL
3
POSTED CRUDE PRICES, MONTH AVERAGE
MID-CONTINENT 38 - 38.9°
J F M A M J J A S O N D
1951
F M A M J J A S O N D
1952
F M A M J J A S O N D
1953
F M A M J J A S O N D
1954

In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate and fuel oil. Realization averaged $3.66 for week ended March 20, $3.69 for previous week, and $3.34 for March 1953. The above trend information is based on volumes and current prices and therefore does not reflect changes in operating costs.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of March 31, 1954. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for resident fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline	10.75-11	11.5-12.25	10-10.5
Premium gasoline	11.75-12	13.25-14	11.5-12.25
42-44 w.w. kerosine	9.125-9.375	10.2-10.4	9.25-9.5
No. 2 straw fuel oil	8.25-8.375	9.2-9.4	8.25-8.5
No. 6 residual	$1.20-1.30	$2.20-2.40	$1.85-1.95

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	4.5	4.0	4.25
Grade 18-55	5.4	4.9	5.15

LUBRICATING OILS
South Texas

200 vis., No. 2-3 Neutral	12.5-13.75
750 vis., No. 3-4 neutral	15-15.5
2,000 vis., 5-6 neutral	16-17

LUBRICATING OILS
Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	19
200 vis., No. 3 neutral, 0-10 pp.	14.25

Western Pennsylvania

145-155 vis., 10 p.t. bright stock	18.5
180 vis., 10 p.t. neutral	22.5

WAX
Mid-Continent

132-134 A.M.P.	6.0

CARGO prices for gasoline on the Gulf Coast moved up 0.5 cent a gallon from the very low quotation of 9.5 cents for 87 octane. A gasoline price war at the cargo level resulted in a drop of 1.0 cent a gallon within a few days just after the middle of March. The low quotations were for immediate shipment, and only a few potential purchasers had tankers available for loading during the period of a little more than a week that the prices were so low.

The increase of 0.5 cent to 10.0 cents a gallon for 87 octane did not indicate any appreciable strengthening of the Gulf Coast market. The restoration of half of the original cut resulted from a truce in the price war.

The lack of strength in the Gulf Coast gasoline market is shown by the effect on quotations for natural gasoline. Overflowing gasoline tanks on the Gulf Coast caused a few refiners to stop buying natural gasoline. Others reduced purchases of natural so that receipts of natural are proportional to shipments of motor fuel rather than to production.

Grade 26-70 natural was reduced to 4.5 cents a gallon for the Group 3 market and to 4.0 cents for North Texas. This reduction leaves a spread of 5.25 cents a gallon between the quotation for 26-70 natural and the low for regular gasoline on the Group 3 market.

Recent reductions in heating-oil prices on the East Coast are tending to weaken the market on the Gulf Coast. The low quotation for No. 2 fuel dropped 0.25 cent a gallon to 8.25 cents. The same reduction in kerosine followed a few days later. Some suppliers felt that demand for jet fuel could prevent a reduction in prices quoted for kerosine, but the kerosine component of only about 20 per cent of total jet fuel was not enough to prevent an oversupply of kerosine on the Gulf Coast. A very small surplus was enough to change the market at the end of the heating season.

CRUDE PRICES
GRAVITY SCHEDULE

	Signal Hill, Calif.*	Oklahoma, Kansas	Gulf Coast Tex.†	West Tex.‡
14-14.9	$1.87	....	....	....
15-15.9	1.93	....	....	....
16-16.9	1.99	....	....	....
17-17.9	2.05	....	....	....
18-18.9	2.11	....	....	....
19-19.9	2.18	....	....	....
20-20.9	2.24	$2.50	....	$2.37
21-21.9	2.30	2.52	....	2.39
22-22.9	2.37	2.54	....	2.41
23-23.9	2.45	2.56	....	2.43
24-24.9	2.53	2.58	$2.91	2.45
25-25.9	2.61	2.60	2.93	2.47
26-26.9	2.69	2.62	2.95	2.49
27-27.9	2.76	2.64	2.97	2.51
28-28.9	2.83	2.66	2.99	2.53
29-29.9	2.91	2.68	3.01	2.55
30-30.9	2.97	2.70	3.03	2.57
31-31.9	3.04	2.72	3.05	2.59
32-32.9	3.12	2.74	3.07	2.61
33-33.9	....	2.76	3.09	2.63
34-34.9	....	2.78	3.11	2.65
35-35.9	....	2.80	3.13	2.67
36-36.9	....	2.82	3.15	2.69
37-37.9	....	2.84	3.17	2.71
38-38.9	....	2.86	3.19	2.73
39-39.9	....	2.88	3.21	2.75
40 and above	....	2.90	3.23	2.77

*Standard Oil Co. of California. †Upper Texas Gulf Coast ‡Includes New Mexico Permian.

Prices East of California effective June 15, 1953. California prices effective February 16, 1953. Pennsylvania Grade prices effective January 1, 1954.

FLAT CRUDE PRICES

Representative posted schedules per barrel.

Louisiana:	
Cotton Valley (distillate)	$3.00
Cotton Valley (Holloway crude)	2.95
Texas:	
East Texas	2.90
Chapel Hill	2.83
Conroe	3.13
Van	2.73
Pennsylvania Grade:	
Bradford	3.76
Middle District	3.70
Southwest Pennsylvania	3.31
West Virginia	3.25
Ohio	3.24
Illinois Basin	3.02

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EQUIPMENT FOR SALE

FOR SALE: 1954 Failing Model 1500 heavy duty drill and water truck with accessories, available immediately. Perfect condition. Soil Testing Services, Inc., 3521 N. Cicero Avenue, Chicago, Illinois.

FOR SALE: Brand new Hercules Model DOOC 55 H.P. 4 cylinder diesel engine; excellent buy. Also 20 used electric motors from 7½ to 40 H.P. All are 3 phase 220 volt. Priced to sell. The Sanderson-Cyclone Drill Company, Orrville, Ohio.

FOR SALE: 10,341 ft. new 2⅜-in. drill tubing, 6.26 lb., J-55, E.U., Pittsburgh Acme, six-thread, with 500 N-80 couplings. Diamond Drilling Co., 2759 East Willow, Long Beach, Calif.

FOR SALE: ENGINE—165 Hp. Climax T-61 on Skid. Herndon Drilling Company, 421 Mayo Building, Tulsa, Phone 4-9700.

EMSCO 300 Rotary Drilling Rig complete with 2 W.A.K. Waukesha Engines compounded; 6,000' 4½" drill pipe, no mast. Now operating in Stephens County, Oklahoma. Box H-104, The Oil and Gas Journal, Tulsa, Oklahoma.

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PIPE. New seamless J55 mill end 5½" and 7" from Pueblo mill. Get our low prices. Pressey & Son, Pueblo, Colorado.

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EQUIPMENT FOR SALE

FOR SALE—COMPRESSOR UNIT: Wilson Supply-Ingersoll-Rand, Type ES-1 LeRoi Engine Belt Driven Two Stage, Portable "Packaged" Compressor, Prime Mover, LeRoi Model H-2000—Intake Pressure, 20 PSIG; Discharge Pressure, 700 PSIG; Capacity 735,000 CFD. All above Skid Mounted, complete with Cooling Tower. Located Approximately 35 miles SE of Midland, Texas, in Spraberry Area, Used Approximately 30 Days. Please contact Sohio Petroleum Company, J. R. Williams, Jr., 1300 Skirvin Tower, Oklahoma City, Oklahoma. Phone RE 9-0511 for additional information.

EQUIPMENT FOR SALE

250,000 FT. 8⅝ o.d. pipe with collar and plain end. $1.00 per foot Oklahoma. Rogers & Lundquist, 620 Wright Building, Tulsa, Okla. Phone 3-2072—5-8850.

TWO R.L. CARDWELL DOUBLE-DRUM SPUDDERS with 85-ft., 4-leg masts, one with 185 hp. W.A.K. and other with 145 hp. G.A.K. Waukesha motor. Draw works and motors recently overhauled. Each has 9,000 ft. ¾ in. line and 8,000 ft. ⅝ in. line. Dog houses, small tools. S. R. Lesseig, GA 71932 or P.O. Box 6206, Okla. City, or W. D. Cunningham, 89K4, Alma, Okla.

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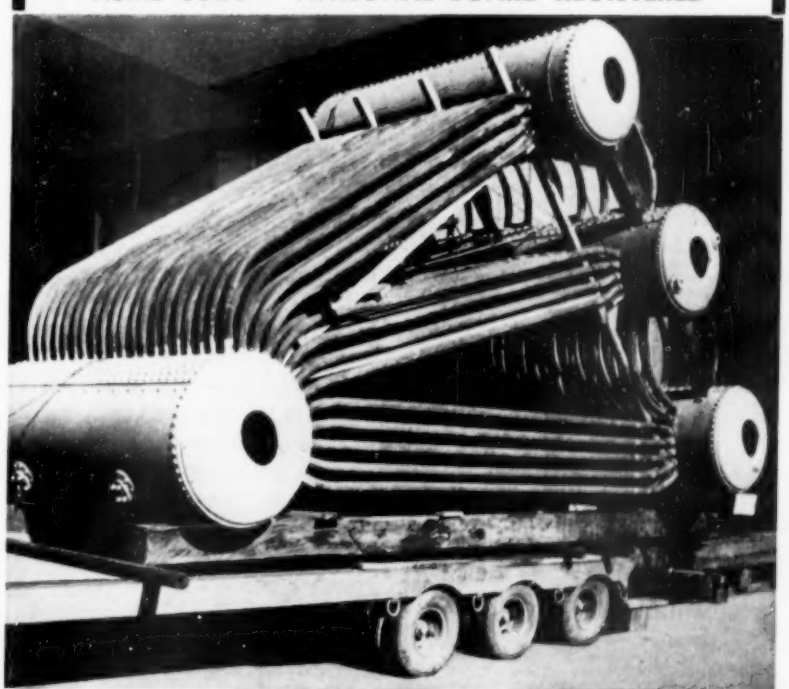

16—777 HP (7,777 sq. ft. of heating surface).
8—850 HP (8,500 sq. ft. of heating surface).
All boilers are 4-drum, for 225# operating pressure, equipped with standard superheaters, designed for 128° F. superheat or a total of 525° F. Standard auxiliaries.

NATIONAL METAL & STEEL CORP. Dept. OJ, Terminal Island, (Los Angeles Harbor), Calif.
Phone: NEvada 6-2517

EQUIPMENT FOR SALE

SALES and rentals of cable drilling and fishing tools, casing and equipment, from the Southwest's largest stock of used cable tools and oil field supplies. Degen Pipe and Supply Co., Tulsa, Oklahoma.

FAILING model heavy duty 1500 drill and water truck. Write to Box 819, Longmont, Colorado, for details.

FOR SALE: Two 18-trace sets of Reflection Seismograph instruments, Rack and Panel mounted. One set mounted in instrument cab, on 1951 GMC Truck, model 301-24. Very reasonably priced. Texas Seismograph Co. Box 2069. Phone 3-1493. Wichita Falls, Texas.

TWO N-K WAUKESHA DRILLING ENGINES. A-1 condition guaranteed. Skid mounted for U-15 draw works. Wallace Engine & Supply. Phone ME 71988, 1915 S.E. 29th, Oklahoma City.

FOR SALE: 23,000 ft. new ½" .85# Black T&C Standard Pipe while it lasts at 6c per foot. 15,000 ft. New 6⅝" O.D. 18.97# DRL Electric Weld P.E. Line Pipe, Bev. Large stock used casing and tubing. Box H-105, The Oil and Gas Journal, Tulsa, Oklahoma.

REED WIRE Line Core Barrel complete with accessories for use with 4½" drill pipe. Practically new, $1,000.00. Carbons Consolidated, Inc., P. O. Box 2927, Monroe, Louisiana.

FOR SALE: Cardwell RL double-drum spudder complete with tools, now working in Oklahoma, also Hydraulic casing pulling machine complete with tools. Phone ME 7-2242, Oklahoma City, Oklahoma.

VALVES

We have about 600 tons of valves ranging from ½" to 12", in brass, cast iron and steel, and in various working pressures, in good condition. We offer these for immediate sale on a unit or tonnage basis. Make us an offer. Write or phone P. C. Houston, Summer & Co., 3937 Main St., Kansas City, Mo. Phone JEfferson 6400.

Gaso Duplex 4½" x 6" Power Pumps with Chrysler C-36 Engines, skid mounted, immediate delivery. Also Byron Jackson, Carter Centrifugal Units, Westinghouse 20-25-50 KW Generating Units

H. H. COFFIELD
Attn.: W. H. ORR
Phones: 132—Rockdale, Texas
AT-3427—Houston, Texas

PONTOONS—BARGES—FLOATS

We have another lot of those fine pontoon sections that we offered last year. These are surplus army equipment and are adaptable to almost any need for floating anything. They are made of steel plate, and weigh about 1 ton per section. They are filled with air-foam to render them virtually unsinkable. The sections can be joined together to form almost any size barge or float. We offer these at a small fraction of their original cost. Price $40.00 per section, F.O.B. Columbus, Ohio.

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Tulsa 3, Oklahoma

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MODEL H CARDWELL Servicing Unit. Truck mounted with mast. Fully equipped. Box No. 1 or Phone 153, Canton, Kansas.

FOR SALE: 5½" x 20" Class 'Y' Cooper Compressor Cylinders, 90 hp. Superior Compressor skid mounted, 4"—500 lbs. gate valves, electric driven centrifugal water pumps. Alfred B. Kern, 227 Wright Building, Tulsa 3, Oklahoma.

EQUIPMENT WANTED

URGENTLY NEED fifty 55,000 bbl. or larger tanks. Must be in blocks of 5 or more. Location immaterial. J. R. Burnett, Box 166, Tulsa.

WANTED: WALKER-NEER S-32 or S-43. Not older than 1950 or 36-L Bucyrus-Erie Spudders. B. R. Sole, Box 722, or Phone 1155, Pawhuska, Oklahoma.

WANTED IMMEDIATELY: Ductility machine, penetrometer, and other asphalt lab equipment. Box H-122, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Complete Rotary Rig, U 15 or National 50 Class, preferably located in West Texas. Box H-106, The Oil and Gas Journal, Tulsa, Oklahoma.

WILL PAY highest prices for used casing, used line pipe, abandoned leases, or other surplus lease equipment. Your idle producing equipment is worth dollars. Green Pipe & Supply Co., Box 1383, Tulsa, Oklahoma.

HELP WANTED

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co., Box 2603, Tulsa, Okla. $5.00 cash.

OIL INDUSTRY Employment Service, Tom Robinson, owner, 405 Tuloma Bldg., Tulsa, Oklahoma. For technical and trained oil industry personnel. Write for blank.

WANTED: Energetic, conscientious, economy-minded, capable petroleum engineer as production superintendent for well-established independent company. Experienced in completing, equipping, drilling practices, taking BHP and OGR tests. Prefer man who has been employed by independent company. Excellent opportunity for one with real ambition and free to travel Mid-Continent area. Replies strictly confidential. Give complete data and salary expected. Box H-119, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER, Civil or mechanical, must have construction experience and be qualified to get a big job done with precision. People of less ability should not apply. 907 Sharp Building, Kansas City, Mo. VIctor 8533.

PETROLEUM OR RESERVOIR ENGINEER

With minimum 3 years' experience in development, production and oil and gas reservoir engineering on primary and secondary recovery problems. For New York office of major foreign producer. Write giving full particulars regarding personal history and work experience. Please include telephone number.

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HELP WANTED

PARTY CHIEFS, Computers, Observers, Engineers, and Shooters by Major Oil Company. Parties will be located in Texas. Give educational background and experience in letter. Reply to Box H-129, The Oil and Gas Journal, Tulsa, Oklahoma.

PHOTOGEOLOGIST—To head photogeologic interpretation section. Must be College graduate—5 years experience—mining experience desirable. Write giving age, education and full details of experience. All replies confidential. Box G-968, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL SECRETARY: Age 35 to 50, for independent oil company in Okla. City. Must be expert Stenographer, well experienced in oil production and operations. Excellent salary with raises commensurate with ability. Give references. P. O. Box 1824, Oklahoma City, Oklahoma.

WANTED, GAS ENGINEER, must have college degree and at least 7 years experience gas and oil production, treating and transmission. Independent Producer, East Texas. Box H-118, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

NATURAL GAS & PETROLEUM ENGINEER, 29, six years varied experience in production, completions, reserves, unitization, repressuring, cycling & plant operation. Desire connection with independent or consultants. Box H-115, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION: Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 8. Ph. No. 3-3141, Hobbs, New Mexico.

REFINERY EQUIPMENT Inspector, Thermal, Catalytic, Platforming. Varied Refining Experience. Box H-124, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPERIENCED drilling, completion, production superintendent available for progressive organization. Engineering graduate, 7½ years major company experience. Age 37, married. Box H-112, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPERIENCED GRADUATE PETROLEUM ENGINEER desires responsible position with aggressive independent or individual in Rocky Mountain region. Box H-127, The Oil and Gas Journal, Tulsa, Oklahoma.

SECONDARY RECOVERY: Penn State Petroleum Engineering graduate; 21 years thorough experience, all phases field and engineering work. Thos. O. Glenn, 221 North Perry St., Titusville, Pa.

PETROLEUM ENGINEER, Age 32, competent, aggressive; experienced in production, drilling, reservoir analysis, proration. Desires responsible position in Rocky Mountain Area. Box H-131, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM Engineer — Graduate—Four and one-half years experience in primary and water flooding with major desires connection with independent. Box H-134, The Oil and Gas Journal, Tulsa, Oklahoma.

Experienced oil company manager desires position with independent group. Technically trained, under 40, experienced in all phases of exploration and development of oil and gas properties. This includes unitization, plants, pipe lines, financing. Presently employed as manager. Box H-108, The Oil and Gas Journal, Tulsa, Oklahoma.

MANUFACTURERS' REPRESENTATIVE

Covering Southern Oklahoma and North Central Texas, desires additional accounts in oilfield production and drilling equipment. Reply—

Box H-101
The Oil and Gas Journal
Tulsa, Oklahoma

SITUATIONS WANTED

PETROLEUM - Mechanical Engineer, 27, family, B.S. degrees from Texas A. & M. 7 years experience in all phases of drilling, production, completion. Currently employed as an assistant drilling-production superintendent with large independent oil company. In addition makes all companies reserve and valuation studies. Desires similar connection with aggressive independent in Houston. Box H-132, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST: 31, married, B.S. Degree Texas A & M College, 5 years' experience in Gulf Coast and Venezuela. Exploration, exploiting, reservoir and regional studies, reserve estimates and administrative background. Foreign or domestic operations. Box G-994, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION INDEPENDENT PRODUCERS: Has the gas-natural gasoline aspect of your business grown big enough to need expert attention? Registered chemical engineer, 42, presently gasoline plant superintendent, has the technical and business sense to do the job. Box H-125, The Oil and Gas Journal, Tulsa, Oklahoma.

RANCHES

RANCH on White River. 1300 acres, Carroll County, Arkansas. Good hay meadows and pastures. Modern owner's lodge with two fireplaces. Modern foreman's house. Good modern barns, corrals. Fenced and cross-fenced. Nine improved permanent springs. Price $40,000. For details write C. C. King, Eureka Springs, Arkansas.

BUSINESS OPPORTUNITIES

WANTED: Good late model Spudder or Rotary Drilling Rig, on Working-Interest basis. Depth 2,500 to 3,000 feet. Can keep Rig working. Give full details in first letter. Box H-133, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL FIELD Supply and Service Companies . . . get new customers . . . keep old customers. Here's how . . . mail Nutville News, 4 page house organ to your regular and prospective customers. Builds good will. Free sample and plan. Write today. Ad-Creators, Box 1313, Hutchinson, Kansas.

HAVE GOOD 6,000 ft. Rotary Rig. Will consider working interest to party who can keep it working. State proposition. Box H-102, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION WANTED

OIL AND GAS OWNER — PRODUCERS Well-managed petroleum-producing company with considerable acreage in several states, embarking upon a large expansion program seeks to absorb other producing properties on a merger basis. Ultimate plan is to invide public participation through stock offering

Box H-130, The Oil and Gas Journal Tulsa, Oklahoma

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of principal officers of
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1994 Gas Producing Companies
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346 Gas Purchasers

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LEASE AND DRILLING BLOCKS

FOUR PRODUCING, paying leases for sale, old production. Will react to secondary recovery methods. H. A. Miller, Glasgow, Kentucky.

WANTED: Small blocks, oil, gas leases for secondary recovery. Box G-964, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: 320 acres, small Hunton well, Nemaha County, Kansas. Thousand acres offset leases. Sell or farm out cheap. R. D. Swan, Daniel Bldg., Tulsa.

WILL pay cash instantly for lease (large blocks), royalties, mineral deeds, production. Write fully—P. O. Box 2153, Denver, Colorado.

SEE A. L. BOWLES, Box 947, Ada, Okla., for attractive drilling deals and producing royalties.

GEOPHYSICAL Exploration and Production Company to drill second off-set well on the Coleman-Brown County line, Texas, in 45 days. 3 possible pay zones. Location on same Fault with several near-by producing Fields. Excellent Geology and Geophysics. Possible new field. 1/16 Working Interest in well and 100 acre lease tract for $640.00. Petroleum Service Company, P. O. Box 1493, Fort Worth, Texas.

80,000 ACRES: Mineral timber land, Tennessee—$3.50 per acre, all mineral rights. Details—E. Jester, 12744 Vanowen, North Hollywood, California.

SELL UNDIVIDED half of all mineral and oil rights of 295 acres. About ninety miles West San Antonio. No rental fee. About ten years to run in Real County, Texas. Make your best offer. C. Cohn, 3900 Walnut Grove Rd., Memphis, Tennessee.

INDICATED FIELD SE NEW MEX.

Well to drill next to S.I. well which showed for prod. 2 zones Permian. Some 1/100th interests in well & blk. at attractive price. Data on request.

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WILDCAT COMPLETIONS

(Continued from page 183)

Fremont County: Pioneer Oil Corp. 1 Government-Pustmueller, NW SW NE 7-33n-94w. Dry. TD 6,677 ft. in Tensleep.

Skelly Oil Co. 1 Tribal, SW SW SW 36-Nn-3w. IPP 231 BOPD. TD 3,384 ft. in Chugwater.

Park County: Sohio Petroleum 1 Government-Simmons, NW NW SE 13-50n-100w. Dry. TD 9,150 ft. Madison.

Weston County: Trans-Tex Drilling Co. 1 Conoco Union State, C NW NW 20-41n-66w. IPF 52 BOPD, Newcastle sand. TD 7,570 ft. in Newcastle.

UTAH

San Juan County: Don Danvers 1 Government, C SW SW 1-37s-18e(SLM). Dry. TD 4,950 ft. in Miss.

COLORADO

Logan County: S. D. Johnson 1 Lebsock, C SE SW 17-7n-53w. Dry. TD 4,841 ft.

E. H. Stone and New World Oil Co. et al 1 Rhodes, NW SE SW 6-6n-53w. Dry. TD 4,450 ft. Lost hole.

Phillips County: Ohio Oil Co. 1 Gall, SW NE SW 23-7n-56w. Dry. TD 5,848 ft. in Morrison.

Prowers County: Terminal Facilities, Inc., 1 Holt "A," NE NE SW 6-6s-43w. Dry. TD 5,500 ft. in St. Genevieve.

SASKATCHEWAN

Socony Sohio 14-13 Bickliegh, LSD 13, 14-27-18w3. Dry. TD 2,285 ft.

Socony Central Del Rio 1 Grassdale, LSD 6, 2-7-16w2. Dry. TD 5,353 ft.

Imperial 7-11-34-23 Guernsey, LSD 7, 11-34-23w2. Dry. TD 1,464 ft.

Alminex 14-5 Crystal, LSD 14, 5-30-27w3. Dry. TD 3,000 ft.

Socony Woodley Southern 11-5 St. Antoine, LSD 5, 11-6-32w1. Dry. TD 3,714 ft.

ALBERTA

Socony Seaboard 35-8 Buck Creek, LSD 8, 35-47-7w5. Mississippian oil well. TD 7,020 ft.

Gulf 7-1 Berry Creek 5, LSD 7, 15-25-14w. Dry. TD 3,700 ft.

Calvan Charter 6-21 Empress, LSD 6, 21-22-1w4. Dry. TD 3,275 ft.

Superior et al 11-33 H. B. Garrington, LSD 11, 33-34-4w5. Dry. TD 10,516 ft.

Stanolind A-1 East Cynthia Crown, LSD 16, 30-51-9w5. Mississippian oil well. TD 6,654 ft.

Socony Seaboard 13-14 Violet Grove, LSD 13, 14-48-7w5. Mississippian oil well. TD 6,700 ft.

Shell 16-25 Reno, LSD 16, 25-80-17w5. Devonian oil well. TD 6,790 ft.

BRITISH COLUMBIA

Pacific 35 Fort St. John, LSD 9, 36-85-22w6. Triassic "D" gas well. TD 5,593 ft.

Knight-Gordon Distributes A. O. Smith Motors in Okla.

Knight-Gordon Engineering, of Tulsa, has been appointed sales agent for Oklahoma and Kansas by the Electric Motor Division of A. O. Smith Corp., according to J. J. Stahl, the motor division's Western district manager at Los Angeles.

A. O. Smith offers motors in a wide range of types and sizes from ⅓ to 500 hp. for most applications.

EQUIPMENT MEN
. . . in the News

Lufkin Acquires Rights On Air-Balanced Pumps

Lufkin Foundry & Machine Co., Lufkin, Tex., manufacturers of oil-field pumping equipment, has announced an arrangement with Lacy Oil Tool Co., Los Angeles, whereby Lufkin acquires sole rights for the manufacture, sales, distribution, and servicing of air-balanced pumping units through the entire oil world, with the exception of California. Lacy Oil Tool Co. will merchandise its air-balanced unit in the State of California only.

The new air-balanced pumping unit offered by Lufkin.

Lacy Oil Tool pioneered the design and development of air-balanced pumping units. Under this arrangement, all design and operational experience which has been accumulated on this air-balanced system by Lacy Oil Tool has been made available to Lufkin, and at the same time, Lufkin will make additional design changes and improvements.

Rockwell Names Farrell Sales Engineer for Texas

Robert M. Farrell, Houston, has been named a sales engineer for Rockwell Manufacturing Co.'s Meter and Valve Division, J. H. Walters, Houston district sales manager, has announced. Farrell will specialize primarily in sales of Nordstrom valves in the Texas area.

A salesman with Oil Center Tool Co. for the past 2 years, Farrell has also done sales work for Ateco Equipment Co., and served as an engineer with Halliburton Oil Well Cementing Co.

McCullough Signs Agreement With Jet Charge Firms

The signing of a cross-license agreement with Byron Jackson Co., Welex Jet Services, Inc., and E. I. Du Pont de Nemours Co., has been announced by I. J. McCullough, president of McCullough Tool Co., Los Angeles and Houston. The agreement covers all the jet process rights of both the McCullough Tool and these companies.

The cross-license is effective immediately, and is retroactive to January 1, 1954, according to the announcement. Through the new cross-license McCullough Tool gains full rights under the patents of these companies, together with its own patents, to the use in oil wells of McCullough jet charges and/or jet charges manufactured by Du Pont.

Bethlehem Announces Gulf Coast Changes

Bethlehem Supply Co., Tulsa, has announced two promotions in the Gulf Coast division.

L. C. Graves has been promoted to the newly created position of special representative in the Gulf Coast division office. He will be responsible for sales promotion of production equipment. Graves, who has been with the company for 15 years, was store manager and field representative at the Odessa, Tex., store prior to his coming to Houston in 1943.

L. C. GRAVES

A. E. WALTER

A. E. (Bobby) Walter was appointed store manager and field representative at the Houston store. Walter has served Bethlehem Supply, Houston, as field representative and assistant store manager since coming with the company in 1947.

S & R Tool & Supply Completes Harvey Plant

The new S & R Tool & Supply Co. plant on the Harvey Canal at Harvey, La.

The S & R Tool & Supply Co., of Houston, has just completed a new building and shops at Harvey, La. The new plant is located on a 20-acre plot on the bank of the Harvey Canal on Peters Road.

The building itself with special loading equipment occupies approximately 20,000 sq. ft. and is constructed of corrugated sheet metal on steel frame. It is equipped with roof light openings and controlled ventilation. Over-all, it extends 300 ft. in length and 70 ft. in width. Three overhead hoists for handling 5, 10, and 20 tons have been installed to expedite shop work.

The plant is completely equipped with new and modern lathes, drill presses, punches, jogs, grinders, and welding units for handling heavy plate work, as well as any small precision jobs. Every facility for the manufacture of heavy-plate specialties such as mud pits, conveyors, utility houses, derrick substructures, and pole masts is available. A fleet of new and modern trucks will be maintained for expediting service to all active oil-field centers.

The building is situated on its own slip off the Harvey Canal with a 100-

ft. wide entrance on a 4½-acre enclosure, which has 2,250-ft. dockage facilities. This will enable all types of coastal barges and marine offshore vessels to have back-door service. A 60-ton crane has been installed on the landing dock and will handle practically every type of loading or unloading job.

The plant will be in operation on a 24-hour a day basis. The new shops will be under the management of Tom Crain, who has been long associated with oil-field equipment, machine work repair, and operation.

Loper Joins Western Co. Staff as Coordinator

RAY LOPER

Ray Loper has joined the staff of The Western Co., technical oil-well service company with general offices at Midland, Tex., as operations training coordinator, Walter Beadle, operations vice president, has announced. Loper has worked closely with Western during the past 3 years on a consulting basis. He received his degree in petroleum engineering from Oklahoma University. After teaching at Oklahoma University for 2 years, he went to Louisiana State University, Baton Rouge, as professor of petroleum engineering. He has resigned from the L.S.U. staff after 4½ years to accept the position with Western.

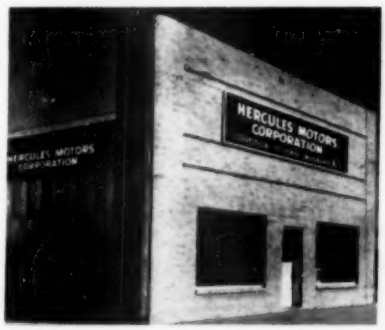
Davey Purchases E.L.I. Drill Unit Business

Davey Compressor Co. has purchased all manufacturing rights to the complete line of portable rotary drilling units previously produced by Engineering Laboratories, Inc., Garland, Tex.

An announcement, issued by J. T. Myers, Davey vice president, stated that transfer of all Engineering Laboratories' operations to Kent, Ohio, is now under way and the delivery schedules will be rigidly maintained.

The purchase included the complete inventory of finished drill units and service parts. Drill unit manufacturing operations at Kent will be handled by a newly established Davey rotary drill division. A substantial portion of the Engineering Laboratories' key personnel will be retained by Davey. The new line includes drill units for exploration, water well drilling, shot holes, core drilling, and shallow oil-well production.

Hercules Motors Corp. Relocates Odessa Branch



The increased demand for engines and power units in oil-field service has resulted in the relocation of the Odessa, Tex., branch of Hercules Motors Corp. The improved and enlarged facilities include a sales room for the display and sales of Hercules engines and power units, enlarged parts department, and more adequate engine servicing facilities. In addition to the improved plant, the new location is readily accessible from all points of the Permian basin oil country of West Texas and Eastern New Mexico on U. S. Highway 80 at the intersection of West County Road. The Odessa branch is under the supervision of William Humphrey, Mid-Continent oil-field manager. C. J. McCulloch is branch manager.

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Aerofin Corporation 141
Ajax Iron Works 24
American Cable Division of American Chain & Cable Inside Back Cover
Ampco Metal, Inc. 141
Armour and Company 35
Armstrong Machine Works 155
Autocar Company, The 37
Baird Mfg. Co. 162
Baker Oil Tools, Inc. 54
Barrett Division of Allied Chemical & Dye Corp. 143
Barton Instrument Corporation 139
Bethlehem Supply Co. 10
Black, Sivalls & Bryson, Inc. 30
Brodie Co., Inc., Ralph N. 9
Bucyrus-Erie Co. 28
Buffalo Forge Company 45
Cable Engineering 170
Carlon Products Corporation 18
Charles Machine Works, The 162
Chase Brass & Copper Co. 46
Chicago Bridge & Iron Company 73
Chrysler Corporation, Industrial Engine Division 29
Clark Bros. Co., Division of Dresser Operations, Inc. 40, 41
Classified Advertising 189, 190, 191, 192
Claymont Steel Wickwire Spencer Steel Division, The Colorado Fuel and Iron Corporation 21
Cleaner Pipelines Co. 158
Climax Engine and Pump Mfg. Co. 49
Continental Supply Co., The 144, 145
Crane Co. 146
Crose Manufacturing Co., Inc., M. J. 141
Dayton Rubber Co. 172
Dean Brothers Pumps, Inc. 163
Dowell Incorporated 113
Drilling & Service, Inc. 179
Eastman Oil Well Survey Company 23
Edward Valves, Inc. 160
Electro Dynamic Division of General Dynamics Corporation 47
Elliott Company 26
Emsco Manufacturing Company 144, 145
Enardo Manufacturing Co. 181
Ethyl Corporation 19, 20
Fairbanks, Morse & Co. 2
Fluor Corporation, Ltd., The 157
Foxboro Company, The 14
France Packing Company 152
Franks Mfg. Corp. Front Cover
General American Transportation Corporation 52
General Electric Company 16, 17, 32, 33
Globe Oil Tools Company 161
Globe Steel Tubes Co. 194
Goodrich Chemical Company, B. F. (Hycar) 115
Grancell, I. H. 160
Guiberson Corporation 148
Gulf-Canal Lines, Inc. 171
Gulf Oil Corporation 22
Gustin-Bacon Manufacturing Co. 175
Halliburton Oil Well Cementing Co. 7, 42
Hopper Machine Works, Inc. 184
Huey & Co., S. E. 159
Hughes Tool Co. Back Cover
Inferno Co., The 162, 170
International Harvester Co. 122
International Nickel Company, Inc., The 56
Jet-Lube Inc. 162
Johnston & Jennings Company, The, Division of Pettibone Mulliken Corporation 154
Johnston Testers, Inc. 31
Jones & Laughlin Steel Corporation Supply Division 15
Kinzbach Tool Co., Inc. 163
Lane-Wells Company 38
Link-Belt Company 5
Lonergan Co., J. E. 136
Macwhyte Co. 3
Manning, Maxwell & Moore, Inc. 27
Mayo Hotel, The 154
McCord Corporation 135
McFarland Manufacturing Corp. 142
Minneapolis-Moline 184
Mission Mfg. Company 130, 131
National Airoil Burner Co., The 152
National Aluminate Corp. 74
National Bank of Commerce, The 39
National Supply Co., The 124
Naugatuck Chemical Division of United States Rubber Co. 8
Nicolet Industries, Inc. 155
Nordstrom Valve Division, Rockwell Manufacturing Company 117, 118
Oil and Gas Journal, The 176, 182
Oil Center Tool Co. 36
Oil Well Supply Co. 4
Otis Pressure Control, Inc. 134
Paris Distributor, Inc., Henry H. 51
Parkersburg Rig & Reel Co. 6
Peerless Supply Co., Inc. 170
Penberthy Injector Co. 11
Penner & Cheney 159
Petroleum Distributing Co. 51
Petreco 12
Phillips Petroleum Company, Perco Division 153
Pipe Line Service Corp. 138
Pittsburgh Lectrodryer Corporation 25
Ratigan, Inc., J. P. 142
Regan Forge & Engineering Co. 175
Reo Motors, Inc. 135
Republic Steel Corporation 177
River Construction Corporation 13
Ryerson & Son, Inc., Joseph T. 174
Sargent Engineering Corp. 120, 121
Scott-Rice Company 162
Simpson Painting Co. 170
Snap-On Tools Corporation 48
Socony-Vacuum Oil Co., Inc. 44
Southern Mill & Mfg. Co. 178
Spang-Chalfant Division of The National Supply Co. 124
Steel Forgings, Inc. 136
Tapecoat Company, The 158
Taylor Chain Co., S. G. 180
Temprite Products Corp. 163
Thomas Flexible Coupling Co. 43
Thornhill-Craver Co. 34
Toledo Pipe Threading Machine Co. 142
Unit Rig & Equipment Co. 126
United States Rubber Company, Naugatuck Chemical Division 8
United Supply & Manufacturing Co. 169
Victor Products Corp. 154
Viking Pump Co. 159
Warner Lewis Company 182
Welex Jet Services Inc. Inside Front Cover
Well Equipment Mfg. Corp. 50
Williamson, Inc., T. D. 137

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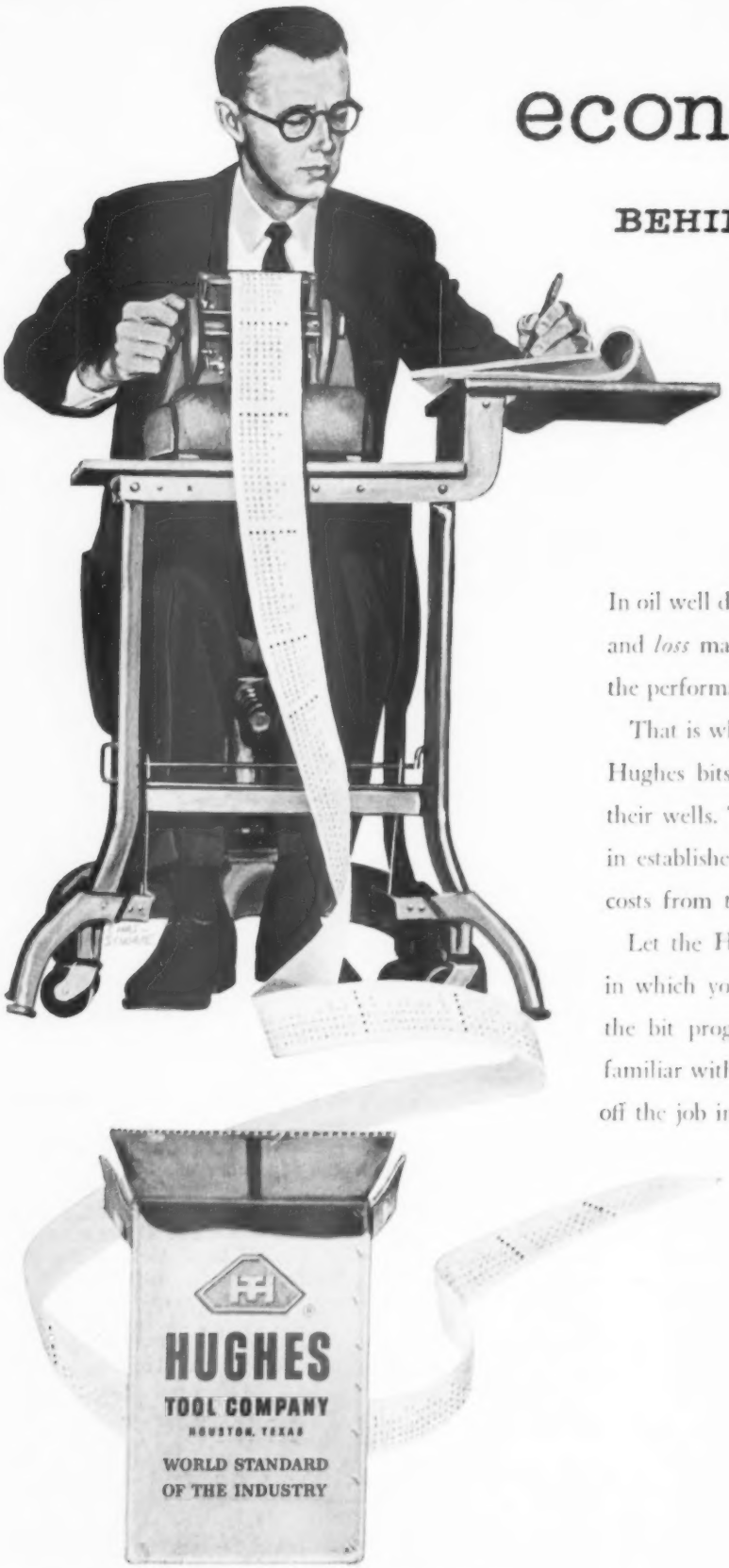

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